Engineering Library

SEP 3 1928

The Engineer.

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VOL. CXLVI.—No. 3789] LONDON: FRIDAY EVENING, AUGUST 24, 1928 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Air Ministry.

FOR SALE: PORTABLE SILICOL HYDROGEN GAS PLANT, mounted on 15ft. by 6ft. chassis. Output about 1000 cu. ft. per hour.

Applications for forms of Tender should be addressed to DIRECTOR OF CONTRACTS, Air Ministry, Kingsway, W.C. 2. 9348

The Director-General,

India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—2150 CAST STEEL or MALLEABLE CAST IRON AXLE-BOXES.

SCHEDULE 2.—WHEEL CENTRES for LOCOMOTIVES.

SCHEDULE 3.—10 CHASSIS for TRAILERS, for Photographic and W.T. Work.

SCHEDULE 4.—CONNECTING-RODS and PISTON-ROD FORGINGS for LOCOMOTIVES.

SCHEDULE 5.—COPPER FIRE-BOX PLATES for LOCOMOTIVES.

SCHEDULE 6.—35,000 UNIVERSAL SIGNAL PULLEYS.

SCHEDULE 7.—141,100 FEET MILD STEEL TUBULAR POINT RODDING.

Tenders due on the 4th September, 1928, for Nos. 1, 2, and 3; on the 7th September, 1928, for Nos. 4 and 5; and on the 14th September, 1928, for Nos. 6 and 7.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 9365

Assistant Engineers (11)

REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. The foregoing officers are required to fill vacancies caused by the increase of the establishment of the Nigeria Public Works Department. Salary £480 a year for the first three years, then £510, rising by annual increments to £920. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates must have attained the age of 21½ years on the date of appointment, and should preferably have attained the age of 22½ and must not be over 25 years of age. Must have obtained an Engineering Degree at a recognised University or have passed Sections "A" and "B" of the A.M.I.C.E. Examination or have passed the Associateship in Civil Engineering of the City and Guilds Institute, or possess such other Degree or Diploma or distinction in engineering as may be considered satisfactory. Candidates whose qualifying Diplomas have been obtained without a College course should have had three years' practical experience of Civil Engineering under a qualified Civil Engineer. It is preferred that all candidates should have had two years' practical experience on good engineering work subsequent to taking their degree or completing their articles, but under certain conditions this may be waived in the case of candidates in possession of an Engineering Degree.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/254. 9243

The Polytechnic, 309, Regent-STREET, W. 1.

SCHOOL OF ENGINEERING.

President of the School: The Hon. Sir CHARLES PARSONS, O.M., K.C.B., M.A., LL.D., D.Sc., F.R.S., &c.

Head of Department: ALEX. R. HORNE, O.B.E., B.Sc. (Hons., Eng.), F.R.S. (Edin.), &c.

The DAY DEPARTMENT RE-OPENS on SEPTEMBER 18th, 1928. Entrance Examination commences 10th September, 1928, at 10 a.m.

Three-year DIPLOMA COURSES in
MECHANICAL ENGINEERING,
STRUCTURAL ENGINEERING,
ELECTRICAL ENGINEERING,
MOTOR CAR ENGINEERING.

Practice in the Laboratories, Drawing-office, Workshop, and Field.

Fee 21 Guineas per annum.

There are Three Entrance Scholarships in Structural Engineering.

The EVENING DEPARTMENT RE-OPENS on SEPTEMBER 24th, 1928. Students enrolled from September 17th, 1928.

The Day and Evening Courses are recognised for the Diplomas and Certificates issued by the Institutions of Mechanical and Electrical Engineers in conjunction with the Board of Education.

Full prospectus free on application to the DIRECTOR OF EDUCATION. 9322

The Polytechnic, 309, Regent-STREET, W. 1.

STUDENTSHIP EXAMINATION OF THE INSTITUTION OF MECHANICAL ENGINEERS.

PRELIMINARY EXAMINATION, INSTITUTION OF CIVIL ENGINEERS.

FINAL EXAMINATION, INSTITUTION ELECTRICAL ENGINEERS (Part 1).

Special Courses have been arranged for Students taking the above Examinations. The syllabus covers all the work in PURE MATHEMATICS, MECHANICS, PHYSICS, ENGLISH and FRENCH.

Fee for the Course £2 2s.

Prospectus free on application to the DIRECTOR OF EDUCATION. 9323

University of Manchester.

PHYSICS DEPARTMENT.

Full particulars of the LECTURES and LABORATORY COURSES in PHYSICS, preparing for both the Ordinary and Honours Degrees, will be forwarded on application to the REGISTRAR. The SESSION COMMENCES on THURSDAY, OCTOBER 4th. 9275

The Engineer

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The FOURTH MACHINE TOOL & ENGINEERING EXHIBITION, OLYMPIA, SEPT. 5th-22nd.

"THE ENGINEER'S" STAND will be No. 39, ROW D, at which all our Friends will be welcome.

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PUBLIC NOTICES

City of Cardiff Education COMMITTEE.

THE TECHNICAL COLLEGE.
Principal: CHARLES COLES, B.Sc. (Lond.).

DEPARTMENT OF ENGINEERING.
Head of Department: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.
SESSION 1928-29.
(Commencing on Tuesday, 2nd October, 1928).

The following Courses have been arranged for Engineering Students :—

A Three Years' Course in Mechanical and Marine Engineering jointly with the University College of South Wales and Monmouthshire.

A Two Years' Course for Apprentices and others with facilities for practical experience in the Summer Term.

These Courses are suitable for Students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

OPEN SCHOLARSHIPS, covering tuition fees and maintenance grants of £40 per annum for three years, are offered for competition annually, and candidates for entry to the above Department are eligible to compete.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application forms for Entrance Scholarship Examination, duly filled up, must be received before September 15th.

JOHN J. JACKSON, Director of Education, City Hall, Cardiff. 9327

University of Bristol.

FACULTY OF ENGINEERING.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT LECTURER and DEMONSTRATOR in MECHANICAL ENGINEERING. Salary, £300 per annum.—Forms of application and full particulars may be obtained from the REGISTRAR, Merchant Venturers' Technical College, Unity-street, Bristol, to whom applications should be forwarded on or before September 5th. 9312

PUBLIC NOTICES

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY are provided in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diplomas and Certificate of the College.

POST-GRADUATE COURSES in CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING are also provided.

HEADS OF DEPARTMENTS :

Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering (Dean).

S. J. DAVIES, M.Sc., M.I. Mech. E., Reader in Mechanical Engineering.

Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.

C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.

Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.

F. S. ROBERTSON, M.I.E.E., Senior Lecturer.

Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 9119

PUBLIC NOTICES

Armstrong College,

NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
8925 Newcastle-upon-Tyne.

The Royal Technical College, GLASGOW.

DEPARTMENTS OF ENGINEERING:

MECHANICS AND MECHANICAL ENGINEERING:
Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.
Associate Professor WILLIAM KERR, Ph.D., A.R.T.C.

ELECTRICAL ENGINEERING:
Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.

CIVIL ENGINEERING:
Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.

MINING ENGINEERING:
Professor DANIEL BURNS, M. Inst. M.E.

CHEMICAL ENGINEERING:
Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.

Complete Courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.

Composition fee 25 guineas per annum.

SESSION 1928-29 BEGINS on TUESDAY, SEPTEMBER 25th.

Calendar, by post, 8s., and prospectus, gratis, may be obtained on application to the DIRECTOR. 9007

University of Manchester.

DEPARTMENT OF ELECTRICAL ENGINEERING.

DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

Full particulars of these Courses will be forwarded on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 4th. 9274

Sunderland Education Committee.

THE TECHNICAL COLLEGE.
DEPARTMENT OF MECHANICAL AND CIVIL ENGINEERING.

The Committee invite APPLICATIONS for the POSITION of LECTURER in the Mechanical and Civil Engineering Department. Applicants must possess a Degree in Engineering of a British University and have had a good practical training and experience in Civil or Structural Engineering. Salary in accordance with the Burnham Award.

Application forms may be obtained from the Principal of the Technical College, Sunderland, and must be returned to the undersigned not later than Monday, 3rd September, 1928.

HERBERT REED,
Chief Education Officer.

Education Offices,
15, John-street, Sunderland,
15th August, 1928. 9305

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PUBLIC NOTICES

City of Nottingham.

BOARD OF GUARDIANS.
HEATING AND HOT WATER SUPPLY PLANT, NURSES' HOME, BAGTHORPE INFIRMARY, HUCKNALL-ROAD, NOTTINGHAM.

The Guardians of the Poor of the City of Nottingham invite TENDERS for the ERECTION of HEATING and DOMESTIC HOT WATER SUPPLY PLANT in the Nurses' Home at the Bagthorpe Infirmary, Hucknall-road, Nottingham.

Tenders must include for the whole of the work specified, and not sections only.

Plans, specification and schedule of quantities may be seen on application to me or to the Consulting Engineer, Mr. T. J. R. Kiernan, B.Sc., M. Inst. C.E., 17, Victoria-street, Westminster, London, S.W. 1, between the hours of 10 a.m. and 4 p.m.

Copies of the plans, specification and schedule of quantities can be obtained ONLY FROM ME, on or after the 27th instant, upon depositing a Five Pound Bank of England note, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Heating Plant, Bagthorpe Infirmary," must be sent to reach me, the undersigned, not later than 4 p.m. on Monday, the 17th September, 1928.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
J. ALLAN BATTERSBY,
Clerk to the Guardians.

Poor Law Offices,
50 Shakespeare-street, Nottingham,
15th August, 1928. 9321

Corporation of Rangoon.

TENDERS FOR STREET FIRE ALARMS.

The Corporation of Rangoon invites sealed TENDERS for the SUPPLY of all necessary INSTRUMENTS and APPARATUS for an INSTALLATION of STREET FIRE ALARMS on the "CLOSED CIRCUIT" PRINCIPLE, for the City of Rangoon. Specification, standard general conditions of works and Tender forms may be obtained from the undersigned at Ten Shillings per set. The Corporation does not bind itself to accept the lowest or any Tender or to assign any reason for the rejection of any Tender.

Tenders will be received by the undersigned up to Friday, the 19th October, 1928, and should be superscribed "Tender for Street Fire Alarms, Rangoon."

Ref. 2914, OGILVY, GILLANDERS & CO.,
67, Sun-court, Cornhill, London, E.C. 3.
9349 Agents for Corporation of Rangoon.

AMENDED ADVERTISEMENT.

Metropolitan Borough of

BETHNAL GREEN.
PUBLIC BATHS AND WASHHOUSES.
HEATING AND VENTILATING INSTALLATION.

The Council invites TENDERS for the WARMING, VENTILATING, HOT and COLD WATER SUPPLY SERVICES, STEAM and CONDENSE CONNECTIONS at the Public Baths and Washhouses in course of erection at Old Ford-road, Bethnal Green.

Copies of the specification, conditions and form of Tender may be obtained on application to the Borough Engineer and Surveyor at the Town Hall, Bethnal Green, E. 2, on payment of a deposit of £2 2s., which will be returned on receipt of a bona fide Tender.

The drawings may be inspected at the office of the Borough Engineer and Surveyor during office hours.

The contractor whose Tender is accepted will be required to pay such rates of wages and observe such hours of labour as are recognised by the trade unions in the locality where the work is done.

Sealed Tenders, in envelopes provided, must reach my office not later than Noon on Friday, the 14th September, 1928.

The Council does not bind itself to accept the lowest or any Tender.

DAVID J. KEEF,
9272 Town Clerk.

Metropolitan Borough of

BETHNAL GREEN.
PUBLIC BATHS AND WASHHOUSES.
LAUNDRY MACHINERY AND PLANT.

The Council invites TENDERS for PROVIDING and FIXING LAUNDRY MACHINERY and PLANT at the Public Baths and Washhouses in course of erection in Old Ford-road, Bethnal Green.

Copies of the specification, conditions and form of Tender may be obtained on application to the Borough Engineer and Surveyor at the Town Hall, Bethnal Green, E. 2, on payment of a deposit of £2 2s., which will be returned on receipt of a bona fide Tender.

The contractor whose Tender is accepted will be required to pay such rates of wages and observe such hours of labour as are recognised by the trade unions in the locality where the work is done.

Sealed Tenders, in envelopes provided, must reach my office not later than Noon on Friday, the 14th September, 1928.

The Council does not bind itself to accept the lowest or any Tender.

DAVID J. KEEF,
9271 Town Clerk.

State Electricity Commission

OF VICTORIA, AUSTRALIA,
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, TESTING, SUPPLY, DELIVERY, ERECTION COMPLETE, and MAINTENANCE of MECHANICAL STEP GRATES and ACCESSORIES, for the Yallourn Power Station, in accordance with Specification No. 28/48.

Copies of Tender form, specification, drawings, &c., will be available upon application to the Agent-General for Victoria, Victoria House, The Strand, London, England.

Charge £1 1s. for three copies of Tender form, conditions of tendering, specification, contract conditions and drawings complete. This charge is returnable under certain conditions as specified in the general conditions of tendering.

Extra copies 10s. 6d. each, not returnable. A preliminary deposit of £50 shall be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 12th November, 1928.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
9224 Acting Secretary.

South Indian Railway Company,

LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. PRESSED STEEL SLEEPERS (approx. 6900 Tons).
2. ROLLED STEEL DISC WHEELS and AXLES (1466 Prs.).
3. WATER CRANES.
4. DOG SPIKES, FISH-BOLTS, NUTS and WASHERS.
5. ELECTRICAL MATERIALS and FITTINGS.
6. HAND-POWER RAM PUMPS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Pressed Steel Sleepers," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, 7th September, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specifications Nos. 1 and 2, of 5s. for each copy of Specifications Nos. 3, 4 and 5, and of 2s. 6d. for each copy of Specification No. 6.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1.
22nd August, 1928. 9350

PUBLIC NOTICES

The Bengal and North-Western

RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

5 LOCOMOTIVE BOILERS,

as per specification to be seen at the Company's offices.

Tenders, addressed to the undersigned and marked "Tender for Loco. Boilers," with name of firm tendering, to be lodged not later than Noon on the 17th day of September, 1928.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
W. R. IZAT,
Managing Director.

237, Gresham House,
Old Broad-street, London, E.C. 2.
22/8/1928. 9354

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for :—

(1) GIRDER BRIDGE SPANS of 8½, 10, 20, 38½ and 40ft. (approximate total tonnage equals 125½ Tons).
(2) 75 COVERED GOODS WAGONS (I.R.C.A. Type M.A./2), complete with WHEELS and AXLES.
75 OPEN GOODS WAGONS (I.R.C.A. Type M.C./1), High-sided, complete with WHEELS and AXLES.

Tenders are due in as follows :—
No. (1) by 10.30 a.m. on Monday, 17th September, 1928 ;
No. (2) by 2 p.m. on Tuesday, 18th September, 1928.

Tender forms obtainable at address below ; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1. 9351

Egyptian Government.

MINISTRY OF COMMUNICATIONS.
APPOINTMENT OF ENGINEER TO SUPERVISE BRIDGE ERECTION.

The Egyptian Government invites APPLICATIONS for the above POST in the State Railway Administration.

Applicants must be of British nationality and should have had at least ten years' experience of Bridge Construction Work with contractors on important public works. The salary offered is £E800 per annum (equal approximately £820) and will be free of Egyptian income tax. The contract will terminate on 23rd December, 1930, unless renewed.

The appointment is subject to strict medical examination and to confirmation by the Ministry concerned.

The selected candidate will be granted a transfer allowance equal to one month's salary for change of residence from England to Egypt.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and/or medical examination.

Application form (No. 47) and specimen contract form may be obtained upon request to the
CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1,
to whom they should be returned, accompanied by full particulars as to education, qualifications, previous experience, personal references, and COPIES of certificates and testimonials.

Envelopes to be endorsed "Bridge Engineer."

Last date for reception of application forms 3rd September. 9335

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, a Real Live MAN with Road Engineering experience, good salesman, organiser, Superintending Office Work Patent Asphalt. Salary £750-£1000 per year.—Applications, which will be treated in confidence, to Box X.Y.Z., Smith's Bookstall, Hull Paragon Station. P4874 A

WANTED, a TRAINED ENGINEER to Assist Works Manager in Supervising Manufacture of Accurate Instruments. A young man with workshop and some drawing-office training and University Degree in Engineering required. Good prospects of advancement for a man of resource and ability.—Address, giving full details of age, training, experience and salary expected, 9282, The Engineer Office. 9282 A

WANTED by an Important Industrial Undertaking in England, a CHIEF ENGINEER. The essential qualifications are technical college training and ten years' experience with High-pressure Boilers, Turbo-alternators. H.T. and L.T. Three-phase Distribution. A knowledge of Steam, Water and Gas Distribution and of Locomotive Work would be an advantage. Age not over 40.

Only thoroughly qualified men need apply.

Salary £1000 per annum.

Applications, giving age, full particulars of training and experience, and accompanied by copies of three recent testimonials, to be addressed to Messrs. PREECE, CARDEW and RIDER, 8, Queen Anne's-gate, Westminster, S.W. 1, and to be delivered not later than Wednesday, the 29th inst. 9328 A

WANTED for Engineering Offices Abroad, ENGINEER, age about 30 (unmarried), having served apprenticeship in British Railway Co.'s Loco. or Carriage Workshops.

Public school man preferred with good technical education. Must have good presence, and be able to interview railway officials.

Good salary will be paid for suitable candidate.

Address, giving full particulars of age, education, experience, &c., 9342, The Engineer Office. 9342 A

WANTED for India, ONE or TWO INDIAN GENTLEMEN who have graduated in Civil Engineering at an English University, to undergo Course of Training in Reinforced Concrete Pipe Construction and subsequently fill appointments in India. —Write full particulars, age and qualifications to Z.L. 395, c/o Deacon's, Fenchurch-avenue, London. 9297 A

WANTED for the East, ENGINEER, with Thorough experience of all branches of Ferro-concrete Engineering, also some commercial knowledge would be required to obtain orders for new construction ; age about 30.—Write, with full particulars, to Z.M. 396, c/o Deacon's, Fenchurch-avenue, London. 9296 A

WANTED, Young WORKS MANAGER for Provinces, experienced in Designing, Draughtsmanship, Toolroom and Workshop. Ability to organise production and introduce costing systems. Age about 25. Send full details, stating salary required. Good treatment, remuneration and encouragement to ambitious hard worker.—Address, 9346, The Engineer Office. 9346 A

AN ENGINEERING ASSISTANT is REQUIRED in the Research Department of a large English Engineering Firm. Candidates should be graduates in mechanical science and have had sound works training of not less than two years. A good knowledge of mathematics and ability to apply it to new problems is essential. Applicants should give full particulars of qualifications, training and experience, and enclose copies of recent testimonials.—Address, 9332, The Engineer Office. 9332 A

CHEMIST, Young, WANTED for Small Laboratory —Write, Box 636, Sells' Advertising Offices, Fleet-street, E.C. 4. 9350 A

SITUATIONS OPEN (continued)

AN ENGINEER-SALESMAN, LONDON STAFF.—Must be thoroughly trained and educated and have complete knowledge of generating plant and switch gear. Proved selling ability absolutely essential. Excellent prospects for young, keen, energetic engineer with initiative, resource and personality. Applications, stating age, experience, selling results already attained, personal references and salary required, will be received in confidence.—Address, 1368, The Engineer Office. 9368 A

ASSISTANT CHIEF REQUIRED for Technical Estimating and Design Work in large Marine Engineering Establishment. Applicants must have wide experience of Boilers, Turbines, Reciprocating and Internal Combustion Engines for tendering purposes. Experience and salary expected to be stated.—Address, "MARINE," Wm. Porteous and Co., Glasgow. P4873 A

HEATING ENGINEERS, Lancashire District, REQUIRE first-class DRAUGHTSMAN. Must have experience in all systems of Heating, Drying, and Ventilating. Applicants must be capable of acting without supervision, be energetic and competent to supervise staff.—Address, 9285, The Engineer Office. 9285 A

MECHANICAL ENGINEER REQUIRED for Twelve Months' Service in the Far East. Considerable experience with usual Contractors' Plant on large public works contracts desirable.—Address, with full particulars of experience and stating age and salary required, 9345, The Engineer Office. 9345 A

PULVERISED FUEL.—WANTED, SERVICES of a capable ENGINEER with a thorough knowledge of the Pulverisation of Fuel, &c. Must have expert knowledge of the laws of combustion and be generally conversant with the design of various types of boilers and furnaces suitable for this system of firing. In making application, please give full details of past experience, stating age, and salary expected, and when able to commence.—Address, 9340, The Engineer Office. 9340 A

REPRESENTATIVES, with Established Connection with engineers, WANTED by Large Ironfoundry. Commission basis. State area.—Address, 9355, The Engineer Office. 9355 A

SALESMAN WANTED by Gas Undertaking ; Experience in Engineering and Shipbuilding more desirable than experience in gas ; good address necessary, and University Degree desirable.—Address, 9266, The Engineer Office. 9266 A

SYNTHETIC AMMONIA and NITRATES, Ltd. (associated with Imperial Chemical Industries, Ltd.) REQUIRE the SERVICES of MECHANICAL ENGINEERS, age 25-32. Applicants must possess first-class practical experience and must have had university or similar technical training. Previous experience on Design and Lay-out Work essential.

The work to be undertaken is the Design of Works Plant.

Duties will commence in the drawing-office, but promotion and salary will be entirely dependent upon ability and personality.

Replies to be addressed to the CHIEF ENGINEER, Synthetic Ammonia and Nitrates, Ltd., Billingham, Stockton-on-Tees. 9317 A

WALLIS and STEVENS, Ltd., Basingstoke, REQUIRE TRAVELLING REPRESENTATIVE for Southern District, to work from Basingstoke ; principal line, Road Rollers and Road Haulage Plant, &c. Good address and some engineering knowledge essential. Age 25/35.

Applications by letter in first place only. P4872 A

WORKS MANAGER WANTED for Firm of Aero-engine Manufacturers. Applicants should have held equivalent position previously ; have had considerable experience of engineering work of highest accuracy and finish, and have an all-round practical knowledge of best shop methods and systems. Ability to handle labour problems satisfactorily is essential.—Address, giving full particulars of qualifications and remuneration required, 9360, The Engineer Office. 9360 A

WANTED, Efficient BOILER PLANT DRAUGHTSMAN, with intimate experience in Design and Lay-out of Chain-grate Stokers, Pulverised Fuel Systems, &c. Good salary and improving position to suitable applicant.

Address, with full particulars as to experience, references, stating when at liberty, 9341, The Engineer Office. 9341 A

WANTED, First-class DRAUGHTSMAN for Constructional Steel Work.

Apply, with references, &c., to R. WHITE and SONS, Engineers, Widnes. 9318 A

WANTED for London Office, SENIOR DRAUGHTSMEN, fully experienced in proposal work for Mechanical Handling Plants. Must be first-class men, capable of estimating and writing specifications.—Address, stating age, experience, salary expected, 9362, The Engineer Office. 9362 A

WANTED IMMEDIATELY, First-class SENIOR DRAUGHTSMEN, with experience of Motor Car Engine or Aeroplane Engine Design.—Address, stating age, experience, and salary required, 9288, The Engineer Office. 9288 A

ASSISTANT DRAUGHTSMAN WANTED on the A. South Coast, Sussex, for General and Water Engineering Work. Salary £3 10s. per week. State experience, age, and if disengaged.—Address, P4869, The Engineer Office. P4869 A

COKE OVEN DESIGNER, Well Experienced and C qualified, REQUIRED.—Write, stating age, experience, and salary, to Z.T. 444, c/o Deacon's, Fenchurch-avenue, E.C. 3. 9366 A

CRANE DRAUGHTSMAN WANTED, with Good C experience in all types of Excavating Cranes. Only those who can work on own initiative need apply. Permanent position for suitable applicant. State in detail experience, age, and salary required.—Address, 9356, The Engineer Office. 9356 A

DRAUGHTSMEN.—HEAD DRAUGHTSMAN and ASSISTANT REQUIRED in drawing-office engaged in producing Bottle-making Machinery. Previous experience in bottle making not essential. Salaries £1000 and £350 respectively.—Address, giving age, qualifications, experience, &c., 9367, The Engineer Office. 9367 A

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DRAUGHTSMAN, with Pumping Machinery Experience, REQUIRED for East Midlands. State experience, previous employers, age, salary required.—Address, 9311, The Engineer Office. 9311 A

FIRST-CLASS DESIGNER DRAUGHTSMAN REQUIRED for Structural Work, Elevating and Conveying, &c. State age, salary required, and when at liberty. Provinces.

Also good IMPROVER, 23/25 years of age.
Address, 9344, The Engineer Office. 9344 A

SITUATIONS OPEN (continued)

LOCOMOTIVE DRAUGHTSMAN REQUIRED AT ONCE in Victoria-street, London. First-class draughtsman with an expert knowledge of Modern Locomotive Practice in design and construction and specially well informed in the design and arrangement of cylinders and valve motions. Must be able to prepare general schemes from instructions furnished by chief designer and complete well-made drawings quickly and accurately. A man of education and good appearance is desired. Must be under 35 years of age, and only men of undoubted ability need apply. Applications, in own handwriting, giving particulars of training and experience, stating age and salary required. All applications will be treated confidentially.—Address, 9325, The Engineer Office. 9325 A

MECHANICAL DRAUGHTSMAN WANTED for Midlands. Some experience of Plant Installation Work an asset, but not essential to a reliable go-ahead junior. State experience, age, and wages required.—Address, 9343, The Engineer Office. 9343 A

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SITUATIONS WANTED

ADAPTABLE YOUTH (17½), Sound Technical training, DESIRES OPENING in which scientific and mathematical inclinations would be advantageous. Reference from Principal, A.M.I.M.E.—M. C., 16, Woodland-road, N. 16. P4885 B

CHARTERED CIVIL ENGINEER (40), Wide Commercial experience gained last nine years managerial position, capable organiser, DESIRES responsible SITUATION with prospects. Excellent references.—Address, P4859, The Engineer Office. P4859 B

ENGINEER, Mechanical, Electrical and Civil Experience, works, commercial, complete factory layouts, erection and control, REQUIRES RESPONSIBLE POSITION. Age 40.—Address, P4868, The Engineer Office. P4868 B

ENGINEER (29) SEEKS APPOINTMENT ; Public school ed., exp. in workshops, D.O., and assist. engineer on works erection and maintenance.—BM/L 024, London, W.C. 1. 9295 B

ENGINEER, Young, Good Technical, Practical and drawing-office experience, DESIRES SITUATION in Agency or Representative's Office or other progressive position. Good address.—Address, P4884, The Engineer Office. P4884 B

INSPECTING and MECHANICAL ENGINEER, M.I. and S. Inst., highest references, young and active, 3 years' experience Continental mills, speaks fluent French, little German, DESIRES APPOINTMENT in Australia, New Zealand, or any other country.—Address, P4841, The Engineer Office. P4841 B

MECHANICAL and MARINE ENGINEER (37), 1st Cl. B.O.T., with very wide experience in all types of ships, tugs, river craft, and of all kinds of I.C.E. and steam plant, dockyard and works management, repair work and maintenance of large concerns, with white or native labour, SEEKS RESPONSIBLE POST at home or abroad. Excellent credentials.—Address, P4870, The Engineer Office. P4870 B

MECHANICAL ENGINEER (38), B.Sc., M.I. Loco. Engineers, works, railways and commercial experience abroad, DESIRES APPOINTMENT.—Address, P4871, The Engineer Office. P4871 B

YOUNG MAN (22), Secondary School Education, technical training, good experience in mach. mass production, slight D.O. experience, SEEKS SITUATION with view of good prospects.
Address,
P4861, The Engineer Office. P4861 B

YOUNG MECHANICAL ENGINEER, 13 Years' factory equipment and maintenance experience, all trades, including D.O. and office routine, good technical training, DESIRES PROGRESSIVE POST. Free now.—Write, L. M., 79, Bridgewater-road, Alperton, Middlesex. P4878 B

DRAUGHTSMAN (Automobile) DESIRES RE-ENGAGEMENT ; technical, staff or D.O.; could take control, long experience of high-class design.—Address, P4880, The Engineer Office. P4880 B

DRAUGHTSMAN, Exp. in Steam, I.C. Engine and electrical work, also fit. and tool work applying to same, DESIRES POSITION in London district.—Address, C. W. CASTLETON, 76, Lee-road, Aldeburgh, Suffolk. P4881 B

For continuation of Small Advertisements see page 4.

"THE ENGINEER" DIRECTORY.

The 1928 Edition of this book is now available for distribution.

The Directory is issued in the interests of advertisers in THE ENGINEER, and, in consequence, is a valuable book of reference, containing, as it does, under many classified headings a very large number of important manufacturing firms.

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GRATIS ON APPLICATION to :

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A Seven-Day Journal

Another Level Crossing Disaster.

FOR the fourth time in a little over three and a-half years there has been a serious accident at a level crossing. On this occasion, in contrast with the cases at Fenny Stratford, Naworth, and Roudham, where motor vehicles were run down by trains at public road level crossings, the accident occurred at an occupation crossing, *i.e.*, a crossing provided for the convenience of the landowner. The scene of the disaster was a level crossing giving access to and from the East Anglia Cement Company's works at Shepreth, and it appears that a motor lorry belonging to a contractor was taking a load of cement from the works when it was struck by an express train from Cambridge to King's Cross. The lorry was destroyed and its driver killed and the whole of the train, consisting of engine, horse-box, and three bogie coaches, derailed. The direction of the engine was reversed, so that it lay with its chimney towards Cambridge, and the fireman was killed. At the inquest on Saturday it was said that there was a clear view of the line for a mile. A verdict of "Accidental Death" was returned, with the recommendation that the Cement Company should pilot its customers over the crossing.

A New Aero Engine.

THIS country is in the fortunate position of having five or six first-class firms actively engaged on the production of aero-engines. As each firm makes several sizes and types the range of designs on which aeroplane manufacturers may draw is very considerable. Some surprise was therefore occasioned two or three years ago when the builders of one of the best-known of our military machines of to-day chose for it an engine of American origin. The explanation given was that no existing British engine presented the small amount of frontal area characteristic of the American design. In the new Rolls-Royce "F" aero-engine the American design referred to will apparently find a serious rival. That engine was demonstrated for the first time in public at the R.A.F Pageant at Hendon in June, and is now, we learn, being produced in considerable numbers for the Air Ministry. It is stated to use less petrol than any other standard aero-engine, the fuel consumption at normal speed and power being 30 gallons an hour. Its reduced frontal area allows the fuselage to be streamlined in an improved manner, and, consequently, increases the speed for a given power. It is estimated that the use of the new engine will enable a bomber to be constructed which, at an elevation of 15,000ft., will be 30 miles an hour faster than any existing R.A.F. single-seater fighter. The engine has twelve cylinders cast in two monobloc sets. The blocks are so arranged as to form a girder to the crank case, with the result that a very rigid engine is obtained.

The Liners Bremen and Europa.

SOME further particulars are now available concerning the two new fast Atlantic liners, the "Bremen" and "Europa," for the Bremen-New York service of the North German Lloyd Company, which were successfully launched at Bremen and Hamburg last week. The length of the ships is given as 938ft., with a breadth of 108ft. and a draught of 32ft. 8in. If the length referred to be that between perpendiculars, then the new liners will be the longest vessels yet launched, although their length will be exceeded by the new White Star liner which is being constructed by Harland and Wolff, Ltd., at Belfast. Should, however, the length given be the overall measurement, then the "Majestic," with a total length of 956ft., is the longer vessel. The breadth is unusually large and it exceeds that of the "Majestic" by over 8ft., while the draught is over 6ft. less than the "Majestic's" and about 3ft. less than that of the Cunarder "Aquitania." Views of the vessels leaving the launching ways show that the hull design embodies some special features. Towards the 'midship section the sides of the ship are carried vertically down almost to the turn of the bilges, giving a very flat bottom. The stem of the ship is straight and slightly receding, and below the water line it is given a definite bulbous form, which is usually associated with naval vessels. The four propellers are of the four-bladed solid type and were made to a special design prepared in Germany. It is of interest, however, to record that they were supplied by the two leading British propeller firms, both of which have works in London.

Traffic Through the Suez Canal.

OFFICIAL statistics with regard to traffic through the Suez Canal, which are published in the most recent issue of the *Bulletin Décadaire*, show that the net transit tonnage for the months of April, May, and June was 8,139,000 tons, compared with 7,853,000 tons for the first three months of the year, which had already constituted a quarterly record. The total transit tonnage for the first half of the present year amounted to 15,992,000 tons, which exceeds by 1,490,000 tons the previous half-yearly record—that registered in the first half of 1927. There was a notable increase in tanker tonnage, and motor vessels formed 14·16 per cent. of the total, compared with 12·2 per cent. for the same period last year. The British-owned tonnage was 56·6 per cent. of the total. There was a marked increase in the German-owned tonnage, which was 9·9 per cent. of the total—a little less than the 10·5 per cent. for Dutch-owned vessels. The *Bulletin* also gives an official account of the successful passage of the Singapore Dock through the Canal, which was the subject of a recent congratulatory telegram sent by the British Admiralty both to the Suez Canal authorities and Swan, Hunter and Wigham Richardson, Ltd., the builders of the dock. The two sections of the dock, in charge of Dutch tugs, entered the canal at daybreak on Saturday, August 4th, and the sea voyage from Suez was continued about noon on August 7th. Special berths were constructed at Kilometre 40, Lake Timsah, the Bitter Lakes at Kabret, and the southern lighthouse, so that part of the time the canal was free for the passage of ordinary shipping. The towing operation was a delicate one on account of the large area of the dock walls exposed to wind and the very small clearance between the dock sections and the walls of the canal. Owing, however, to the very thorough preliminary arrangements and the care taken during the operations, the daily passage of ships through the canal was assured with only small delays of a few hours.

Electric Traction Equipment.

CONTRACTS for large quantities of electric railway equipment representing a sum of no less than £750,000, have been awarded to the Metropolitan-Vickers Electrical Company. Orders have been placed by the Metropolitan Railway, the Southern Railway, and the New South Wales Government Railways, all of which have previously purchased traction equipment from this firm. The Metropolitan Railway contract is for thirty motor coaches completely equipped and a number of equipments for trailer coaches. The new stock will be of the compartment type and it will be used for local and express trains running between the City, Watford, and Rickmansworth. The Metropolitan-Vickers Company has placed the sub-contract for the coach work, underframes and bogies with the Birmingham Railway Carriage and Wagon Company. The Southern Railway contract is for electrical equipment for seventy-two motor coaches and fifty-eight trailer coaches. For the Sydney Suburban Railways of New South Wales the Metropolitan-Vickers Electrical Company is supplying one hundred motor coach equipments and one hundred trailer coach equipments. Each motor coach will be fitted with two 380 horse-power motors, which are claimed to be the most powerful motors so far employed on multiple-unit trains. The electrification scheme covers over 400 miles of track and will make use of the new bridge across Sydney Harbour, for one of the most important extensions which will form a direct route from Sydney city to the north. The contract is the fourth which the Metropolitan-Vickers Company has secured from this railway. The whole of the work for the Metropolitan and Southern railways will be carried out at Trafford Park, Manchester, and will ensure employment for a large number of workpeople for the next twelve months. The remainder of the equipment for the Sydney contract will be manufactured at the Metropolitan-Vickers works at Sydney.

St. Paul's Bridge.

THE considerable amount of attention concentrated recently on the various schemes for the construction of a new road bridge at Charing Cross may perhaps have led some to forget that there is still in existence another scheme for the construction of a bridge lower down the Thames, namely, the St. Paul's Bridge scheme. The Royal Commission on Cross-river Traffic, whose proposals regarding the erection of a double-decked bridge at Charing Cross may now be taken to have been ruled out by all concerned, was equally unfortunate in its suggestions for providing additional bridge facilities within the City. It admitted the necessity for such improved facilities, but decided against the St. Paul's Bridge proposal on the ground that its effect on the Cathedral could not be forecast and because of the interference which it would cause to east and west traffic. As an alternative it proposed the construction of a bridge—the Ludgate Bridge—from Holborn, crossing the river near the existing Blackfriars Bridge. This scheme was examined by the Bridge House Estates Committee of the Court of Common Council, and last January was on the Committee's recommendation abandoned by the Council as impracticable. The Bridge House Estates Committee has already expended over 1¼ million pounds on the St. Paul's Bridge scheme—largely on the acquisition of property—and is not going to give it up lightly. It has recently been reconsidering the question and has, it is understood, decided on certain modifications at the northern abutment which, it is hoped, will satisfy those responsible for the safety of St. Paul's Cathedral. The northern approach under the modified scheme will be moved much further eastwards than in the original scheme. Otherwise the bridge will remain the same as previously planned.

Pulverised Fuel for Marine Purposes.

SOME important experiments on the burning of pulverised fuel in a marine type Scotch boiler with a new type of Todd burner and pulveriser are about to be undertaken at the League Island Navy Yard Research Laboratory, under the auspices of the Fuel Conservation Committee of the United States Shipping Board and the United States Navy Department. The tests will occupy six weeks and the conditions will be the same as those employed in the tests of the Peabody and Fuller-Lehigh burners which have already been made. The new Todd system has been developed during the past two years at the Tebo works of the Todd Shipyards Corporation at Brooklyn. It differs from designs already existent, in that a small unit pulveriser driven by an electric motor is attached to each furnace. The coal, after passing through a preliminary crusher, is delivered direct to the pulverisers at the furnace fronts. It is understood that the new apparatus is very compact and is claimed to embody certain improvements on existing types of equipment. One of the principal features advanced for it is that the use of a small pulveriser at each furnace will prevent the shutting down of a boiler should adjustments or replacements have to be made. It will also be possible to raise steam in a single boiler by running up an auxiliary oil-electric generator set which would provide the small current for operating the pulverisers. The pulverisers are designed to grind the coal so that it will pass through a 200-mesh screen, and they are said to give good regulation of the combustion. The conversion of certain ships to pulverised fuel burning is to be delayed by the Shipping Board until the tests we have referred to are completed.

Ship-repairing Facilities at Falmouth.

AN interesting event took place at Falmouth on Saturday last, August 18th, when an inspection was held of the docks and ship-repairing facilities of the port. A fourth dry dock, which has a length of 611ft., with a breadth of 85ft., has recently been completed. Arrangements have now been made to bunker ships requiring fuel oil, and for this purpose an 8000-ton oil fuel tank has been put down along with two 500-ton tanks for Diesel fuel oil. The wharves have been reconstructed and now have a total length of approximately 2000ft. In the repair shops of the Falmouth Docks and Engineering Company, Ltd., new machinery has been introduced which will enable the hull and propelling machinery repairs of the largest steamers and motor vessels to be undertaken. In another department experimental work on the burning of pulverised fuel in marine type boilers is well advanced. The guests were received by Mr. and Mrs. John H. Silley, of R and H Green and Silley Weir Ltd., London, and by the courtesy of Lord Inchcape luncheon was afterwards served on the motor vessel "Domala." Many shipowners are now finding it convenient to put in at Falmouth for repairs, since it saves the long voyage to the North of England or to the Continental ship-repairing centres. The industrial development of the port owes much to the work of Mr. John H. Silley and the late Mr. Alan Hughes, who for some years was the chairman of the dock undertaking. Alongside this revival of Cornish industry it is opportune to record that the Air Ministry has decided to re-open the Cattewater Marine Air Station on Plymouth Sound, which will serve as a base for a new fleet of all-metal Supermarine Napier seaplanes.

Telegrams in Facsimile.

FOR some time past the General Post Office has been carrying out experiments with facsimile telegraphing, but it is not at present possible to say whether the work done is likely to develop into a public service. Experiments with a German system working between London and Paris have, however, yielded good results. A French system is also being tested between Paris and Bordeaux, but the only public service is between Berlin and Vienna. All the sender of the document for facsimile transmission has to do is to take the special paper issued at the Post Office and write his message or prepare his drawing on it with the special ink provided and hand it across the counter. After certain processes it is then passed through the machine and transmitted to its destination. The time taken for transmission, naturally, varies according to the nature of the message or picture. A picture with a lot of detail requires a very fine "grain" to bring it out effectively and would take longer to transmit than a straight-line drawing or print. In the latest French system devised by Belin a photo-electric cell is employed in place of a kind of mechanical pencil. Facsimile telegraphy is said to be progressing steadily, but the question of whether a public service will be established in this country or not will depend, it is quite evident, largely upon whether there is likely to be a demand for it.

COKE OVEN PLANT AT PARKGATE, ROTHERHAM

(*For description see opposite page*)

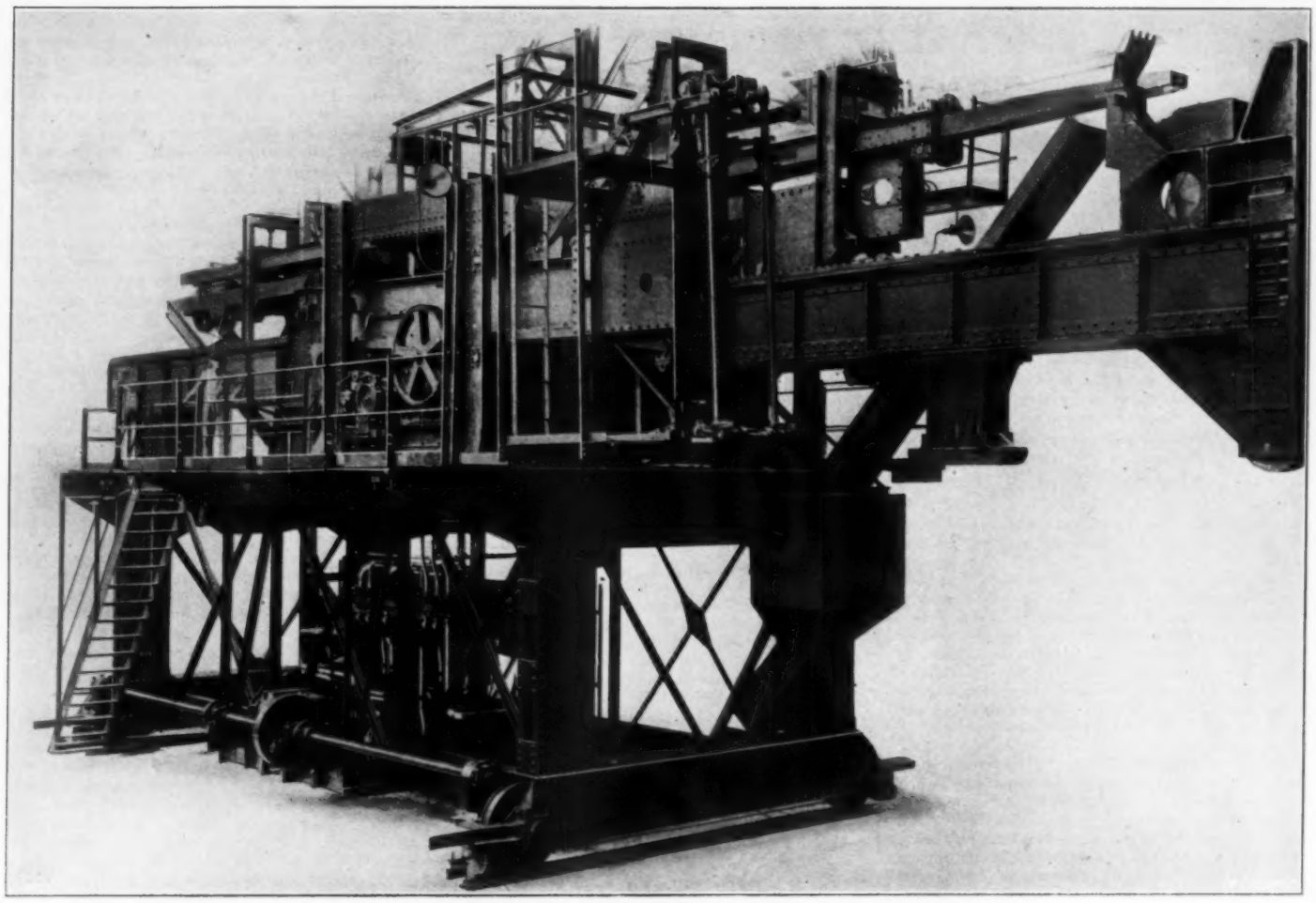


FIG. 13—FRONT VIEW OF COKE PUSHING MACHINE AND DOOR EXTRACTOR

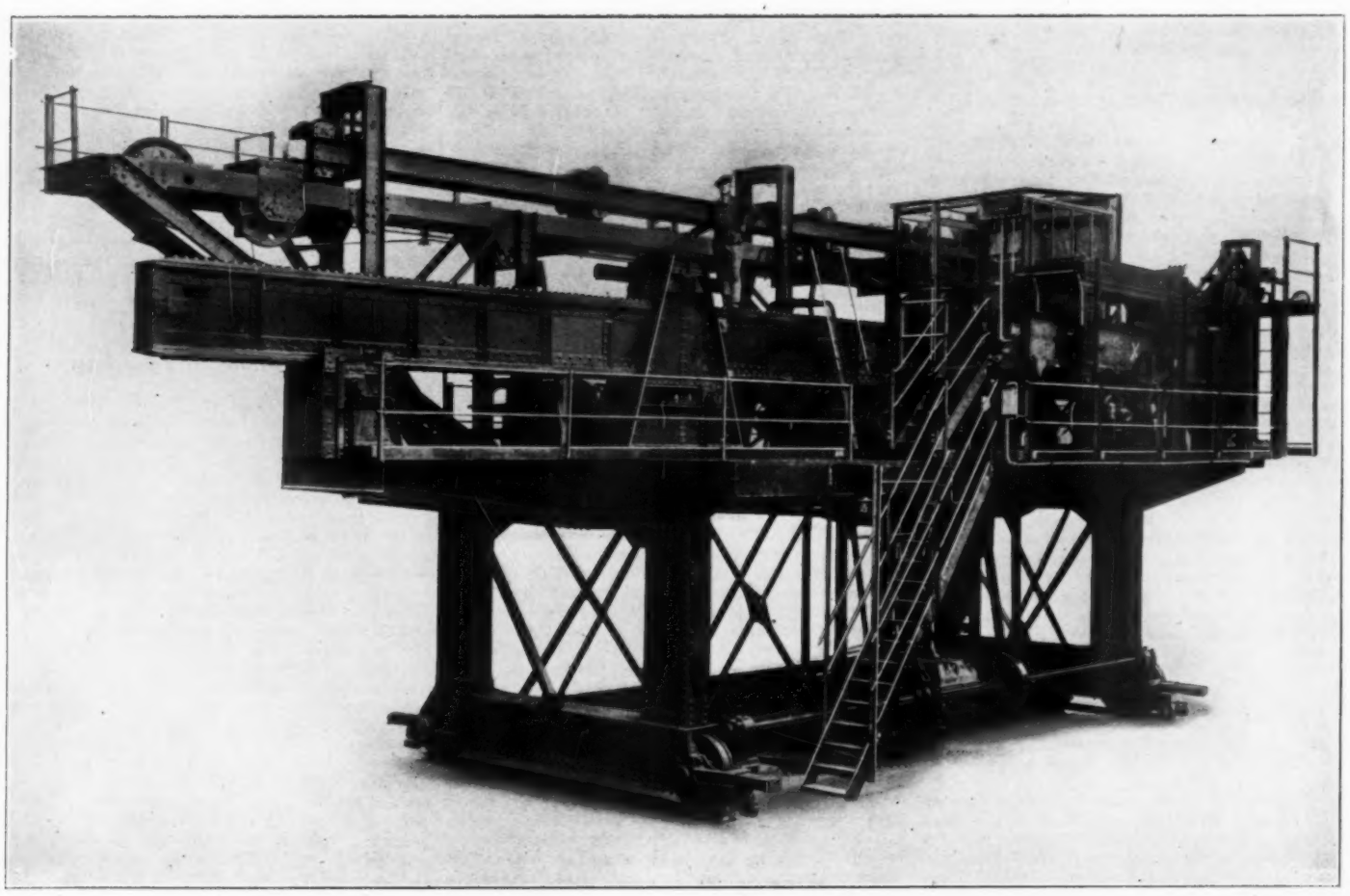


FIG. 14—REAR VIEW OF COKE PUSHING MACHINE AND DOOR EXTRACTOR

A Modern Coke Oven Plant.

No. II. (*Conclusion*).*

COKE-HANDLING PLANT.

HAVING dealt with the production of the gas incidental to the manufacture of coke at the Parkgate works of the South Yorkshire Chemical Works, Ltd., we now come to the handling of the coke, for which purpose a most elaborate equipment of machinery has been installed.

The first operation is, of course, the extraction of the hot coke from the ovens, which is effected by the machine, made by the Wellman Smith Owen Engineering Corporation, Ltd., of Victoria Station House, Westminster, illustrated by the engravings Figs. 13 and 14 and the line drawing Fig. 15. The procedure is as follows :—

A programme is arranged as to the sequence in which the ovens shall be discharged in order to maintain the heat of the battery as uniform as possible. It is, for instance, decided to discharge every tenth oven in rotation. Then, starting with, perhaps, No. 5, all the "fives" (5, 15, 25, &c.) are discharged in succession. Subsequently the "eights," then the "elevens" are dealt with, and so on. By adopting this procedure there is no liability of confusion between the attendants on opposite sides of the battery of ovens. A simple whistle is sufficient to warn one man or the other that everything is ready for the discharge of an oven.

The coke is discharged by forcibly pushing it out at one end of the oven by introducing a ram at the other end. This act is facilitated by the shrinkage of the coal in coking, as it leaves contact with the sides of the oven. Before the coke can be pushed out, however, the doors at the ends of the oven must, of course, be removed. These doors are massive iron castings lined with fire-bricks and weigh approximately 2 tons each. They are held in place by two latch bars which engage with lugs on the oven door frames and are made gas-tight by a luting of mortar prepared in a "Daub" mill.

The mechanism for handling the doors on the ram side is carried by the coke pushing machine and is best shown in Fig. 13, where it can be seen on the left side of the front, while it is also shown on the extreme left of Fig. 15. The mechanism is mounted on the front end of a massive ram, built up of steel plates and sections, which can be racked towards or away from the oven front. There are two distinct parts : first, a set of fingers for lifting the latch bars ; and second, a hooked nose to lift and withdraw the door. The fingers are fixed on the vertical bars seen at the front of the ram and are operated by the levers above. It will be noticed that the levers have rollers on their ends to bear against the oven door and determine their position. The hooked nose can be seen at the top of the ram and is engaged with a recess on the oven door by means of a hand-operated gear. Then, when the driving motor is set in operation, the door is given a slight lift, by means of rollers running on cam paths, in order to break the seal of the luting and is withdrawn from the oven front. Strong springs are arranged between the body of the ram and the working head to prevent any jar when the engagement is effected. The driving motor is of 12 horse-power and works the ram through reduction gearing and a rack and pinion. Limit switches are arranged to determine the travel of the ram. The motor is stopped definitely by the de-energising of a solenoid, which normally holds off a deadweight brake on the limit switch opening. It will be noticed that around the door extractor head there are two platforms for the men who lute the door when it is put back again. The operation of replacing the door is, of course, merely a reversal of the process just described.

When the door at the other end of the oven has been removed, by a nearly similar mechanism, shown in Fig. 16 and described later, everything is ready for the coke to be pushed out and the attendant on the outlet side gives a warning whistle. In the interval the coke-pushing machine has been travelled along a few feet to bring the main ram into position opposite the oven opening, and we noticed that, in spite of its massiveness, the operator had very little difficulty in getting the machine into the exact position.

The ram, as will be seen from Figs. 13, 14 and 15, is a heavy built-up beam 68ft. long, on the front end of which there is mounted a massive cast steel head faced with manganese steel. The ram travels on a set of bushed rollers fixed in the main frame and is provided with cast steel tracks for these rollers. In the centre there is a cast steel rack for the pinion, also of cast steel, which drives the ram backwards and forwards. The tracks and rack are duplicated on the top of the ram, so that it can be turned over when one set is worn, and, incidentally, to minimise distortion through lack of symmetry in the hot oven. Towards the rear of the main structure there is an A-shaped frame—see Fig. 15—straddling the ram and provided with rollers to hold down the back end of the ram when it is extended. There is also a shoe—see Fig. 13—to the rear of the pusher head, which slides on the oven floor. This shoe is capable of adjustment vertically through a distance of 2½in. by means of shim plates. On the top of the ram head there is mounted a pronged scraper, which can be used to clean the roof of the oven, but has never been required. This scraper is pivoted in its bracket and is kept up to its work by a heavy weight. In the event of the scraper meeting an unusual obstruction it hinges back and gives way. The motor for driving the ram is of 50 horse-power.

There is still one more operation which this machine has to perform and that is the levelling of the top surface of the charge of fresh coal in the oven. This is effected by the leveller bar seen at the top of the machine. At the top of the oven door there is a rectangular hole fitted with a hinged cover for the introduction of the leveller bar. The bar is built up of steel plates and cast distance pieces and is 62ft. 6in. long. It is carried by rollers in a channel steel cradle, which is slung from the main structure at three points. The slings can be adjusted by means of turnbuckles, plainly shown in Fig. 15, to raise or lower the bar. Unlike the other two rams, the leveller bar is not operated by a rack and pinion, but is worked by a wire rope. This rope is wound on a winch on the working deck—see Fig. 15—and its two ends are carried over pulleys at the ends of the carrier frame. Both ends are attached to the bar near its rear end. In order to maintain the tension in the rope the rear pulley is mounted in a sliding frame, which can be racked in and out by a pinion. On the pinion shaft there is a drum round which there is wound a rope carrying a counterweight. A ratchet is provided to stop any kick when the bar is being operated. The motor driving the bar is of 30 horse-power and is controlled by limit switches to prevent the bar overrunning.

In connection with the levelling bar of this machine

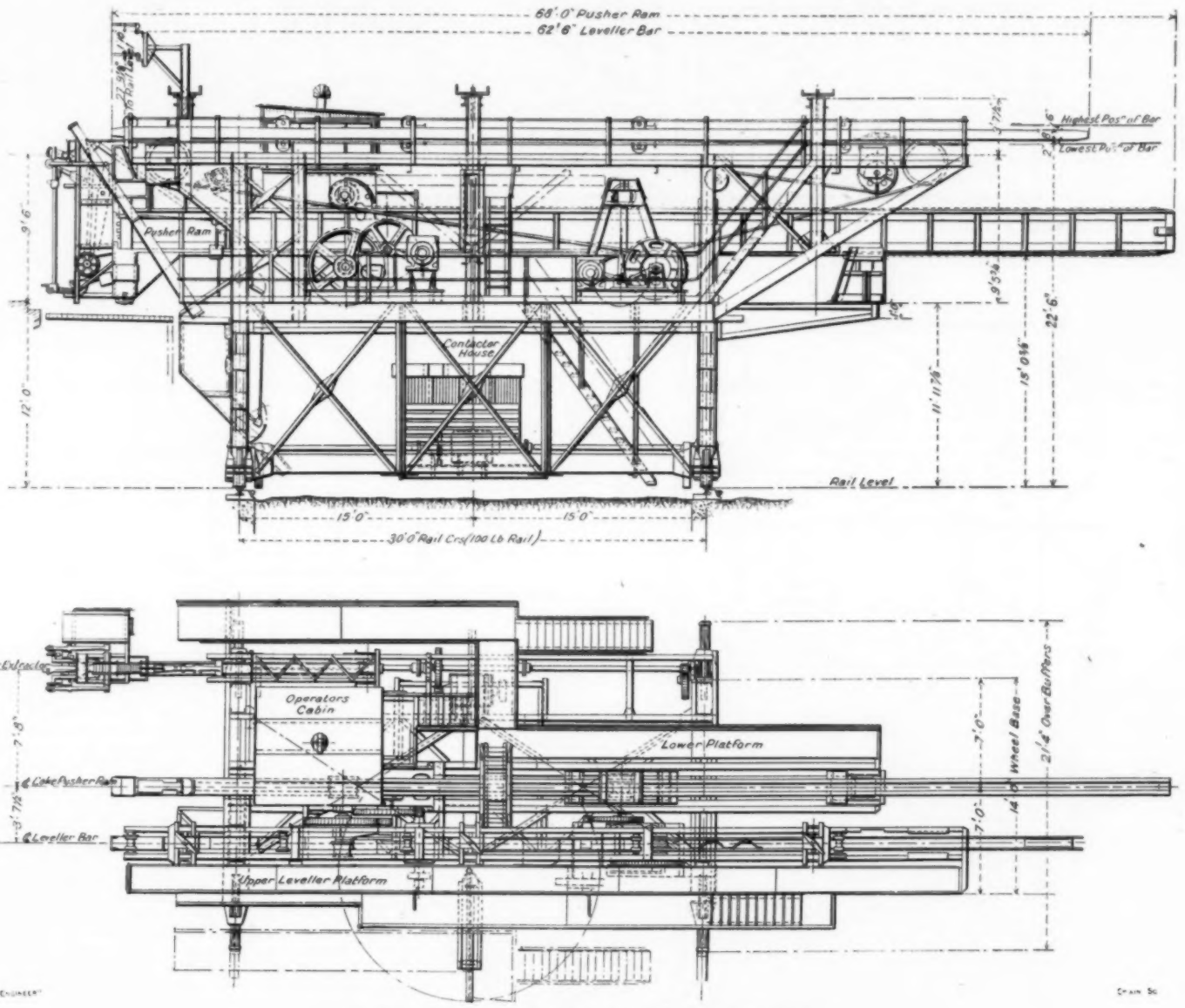
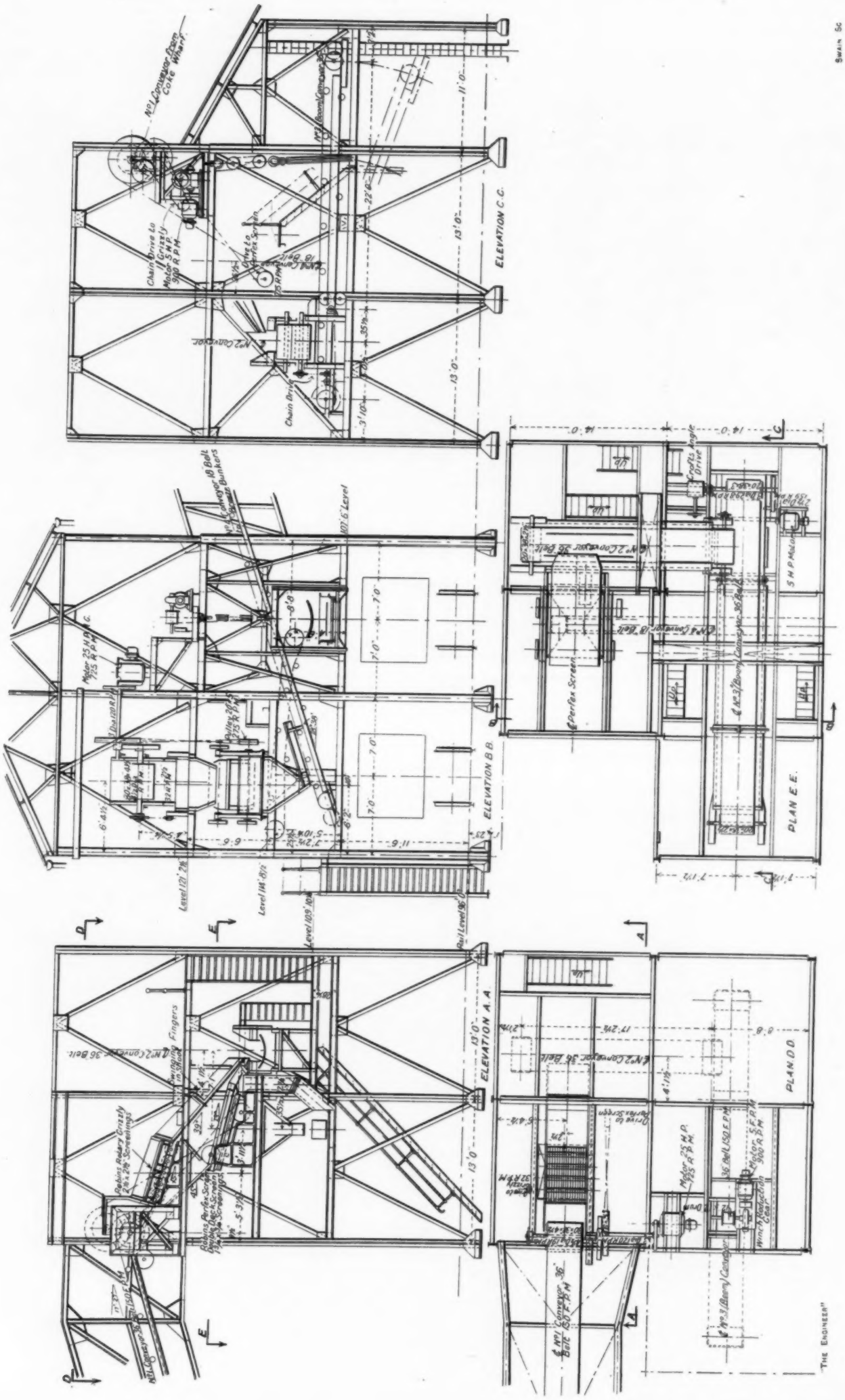


FIG. 15—GENERAL ARRANGEMENT OF COKE PUSHING MACHINE

* No. I. appeared August 17th.

PARKGATE CHEMICAL WORKS—COKE SCREENING AND LOADING PLANT, WITH CONVEYORS



there has been arranged a simple improvement which has added greatly to the cleanliness of its operation. It is obviously impossible to withdraw the levelling bar without dragging back with it some particles of coal, and these have, in the past, dropped on the bench in front of the ovens and needed sweeping up.

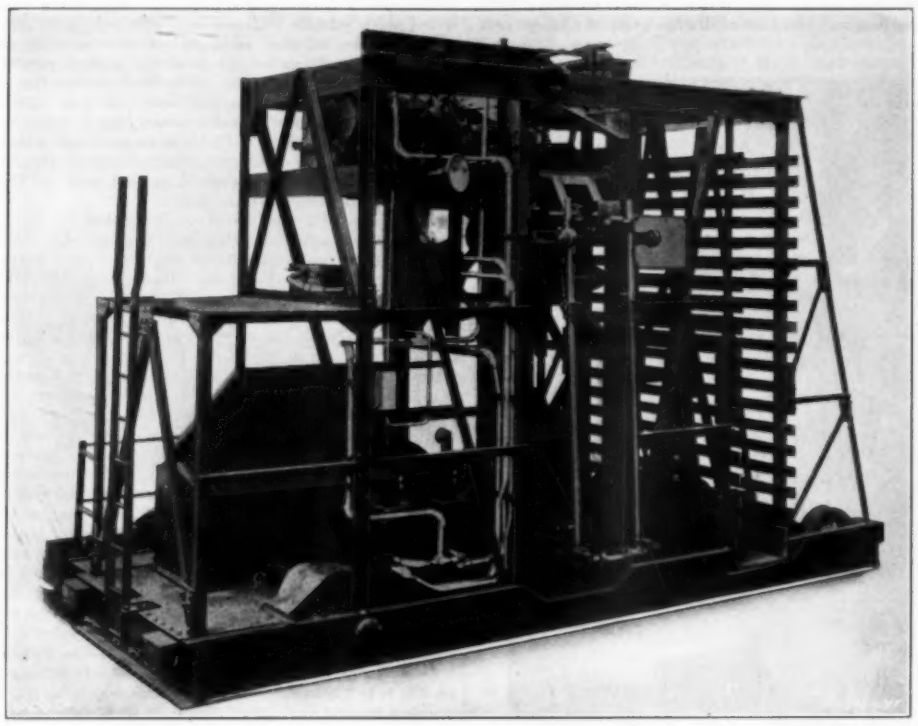


FIG. 16—COKE GUIDE AND DOOR EXTRACTOR

In the case under review, however, a shoot has been arranged directly below the bar—see Fig. 13—and conveys this stuff to a hopper, from which it can be conveniently discharged.

As a precaution against the breakdown of the electricity supply the movements of the coke-pushing ram, also the leveller bar, are provided with crank handles, so that they can be withdrawn from the ovens by hand should any mishap occur. Also there is a complete pushing machine in reserve to take the place of that in service should it be crippled.

We will now go to the opposite side of the battery of ovens, shown in Fig. 10 of our previous article, and witness the discharge of the coke. Needless to relate, it is a most spectacular display—a mass of white-hot coke some 10ft. high by 18in. wide being extruded from the oven at the rate of about 90ft. per minute. The coke is not, however, merely allowed to fall down outside the door, but is taken in charge by the guides seen on the right of the machine shown in Fig. 16 and in Fig. 18, also by the Wellman Company, which lead it clear of the bench necessary for attendance on the front of the ovens and for the accommodation of the door-extracting machine. It should be pointed out in this connection that Fig. 16 shows the machine with the plating of the control cabin removed, and that this plating is very necessary on account of the close proximity of the hot coke to the operator.

COKE QUENCHING.

On reference to Fig. 4 of our first article it will be seen that immediately alongside the battery of ovens, on the discharge side, there is a line of standard-gauge railway metals, on which there runs a special car for the reception of the hot coke. This car—another is kept in reserve in case of emergency—is illustrated by Fig. 17 and was supplied by the Wellman Company. It is mounted on two four-wheeled bogies and is of very substantial construction. The sloping floor and the ends are of cast iron and the doors of cast steel. These doors are operated by compressed air and there are air brakes on all the wheels. The car is 40ft. long and is capable of accommodating the whole of the contents of one coke oven—it will, in fact, take two oven discharges in case of emergency.

The car is manipulated by the electric locomotive shown in Fig. 18, which is equipped with two 75 horse-power railway-type motors and a Westinghouse compressor for supplying air to the brakes and the door-operating cylinders of the car. The locomotive draws its supply of electricity from live rails strung beneath the bench in front of the ovens, by means of the contactors seen on the left. It will be noticed that the driver's cabin is built up to a considerable height, so that he can look over the top of the coke wagon when pushing it in front of him.

When an oven is being discharged the car is brought in front of the oven, and as the coke is tipped into it it is slowly pushed forward, so that the coke is evenly distributed throughout its length. The car is then taken away to the quenching station—see Figs. 2 and 4 *ante*—where the coke is drenched with water.

The quenching station is a tall structure supporting a 14,000-gallon concrete tank, beneath which there is arranged a group of sprays controlled by a solenoid-operated valve. The supply of current for this solenoid is derived from the locomotive through an additional contactor fixed below those shown on the left of Fig. 18. This contactor meets a short length of conductor rail adjacent to the quenching tower, and it is not until contact is made with this rail that the solenoid can be energised, to open the spray valve, by the closing of a switch in the locomotive. It requires about sixty seconds to quench a charge of coke, and some 4000 gallons of water are used in the process. The quenching is carried just so far that there is enough heat left in the coke to evaporate any surplus moisture and the coke is left quite dry. The quenching, naturally, washes out of the coke a considerable amount of fine breeze, and this is carried away with the overflowing water into a settling pond, from which it is occasionally dredged by a steam-operated grab. The water is returned to the overhead tank by one of two Pulsometer pumps—one standby—having a capacity of 500 gallons per minute.

After the coke is quenched, the car is shunted back again to the wharf in front of the oven, the position of which is indicated in Fig. 4 of our first article and which is shown in the centre foreground of the engraving Fig. 1. The wharf, which is a sloping floor of cast iron plates, laid diamond fashion—see Fig. 19—is 20ft. wide by 90ft. long, and on to it the coke is dumped from the car.

CONVEYORS AND SCREENS.

At the lower edge of the wharf there is a barrier in the form of a series of gates made of finger bars, the construction of which is faintly shown in Fig. 19. The man in attendance lifts these gates as may be required and allows the coke to slide forward to a conveyor. The coke is not, however, allowed to drop directly on to the conveyor belt, but is first caught by a revolving drum, like an elongated star wheel, and is fed on to the belt gradually.

The conveyor, like the rest of the coke-handling plant from this point onwards, was made at the Fraser and Chalmers works, and is of the Robins rubber-covered type. The general arrangement of this conveyor and its subsidiaries is shown in Fig. 20, while the drawing on page 192 gives more detail of the screening plant to which the coke is delivered.

The main, or No. 1, conveyor is 258ft. 6in. long between the end pulleys and has a total vertical rise of 40ft. 6in. The belt is a 36in. wide Robins stepped ply with six plies of canvas at the sides and four in the centre. This canvas body of the belt has nothing to do with its resistance to wear, but only takes the tensile stress. In this case the total width of canvas in the cross section of the belt is sufficient to take this load with a pull of 18 lb. per inch of width. To take the wear there is $\frac{1}{16}$in. thickness of rubber cover on the carrying side of the belt and a $\frac{3}{64}$in. thickness on the other side. The speed of the belt is such that it will carry 70 tons of coke per hour, and while performing this duty it requires 8½ horse-power.

At the upper end of the conveyor the coke is discharged on to a rotary grizzly—see Fig. 23, page 202—which has for its object the rapid separation of the large coke, so that the subsequent screen plate is not burdened with unnecessary work. The grizzly comprises a series of shafts on which there are keyed cast iron discs spaced so far apart as to allow the smaller-sized coke to fall through. The shafts are connected together by enclosed chain gearing and are driven at slightly increasing speeds from the top to the bottom. Round the peripheries of the discs there are notches and an occasional projecting tooth. The effect of this arrangement is rapidly to pass on to the outlet all coke over 2½in. in size, while the remainder falls through the grizzly to the screen

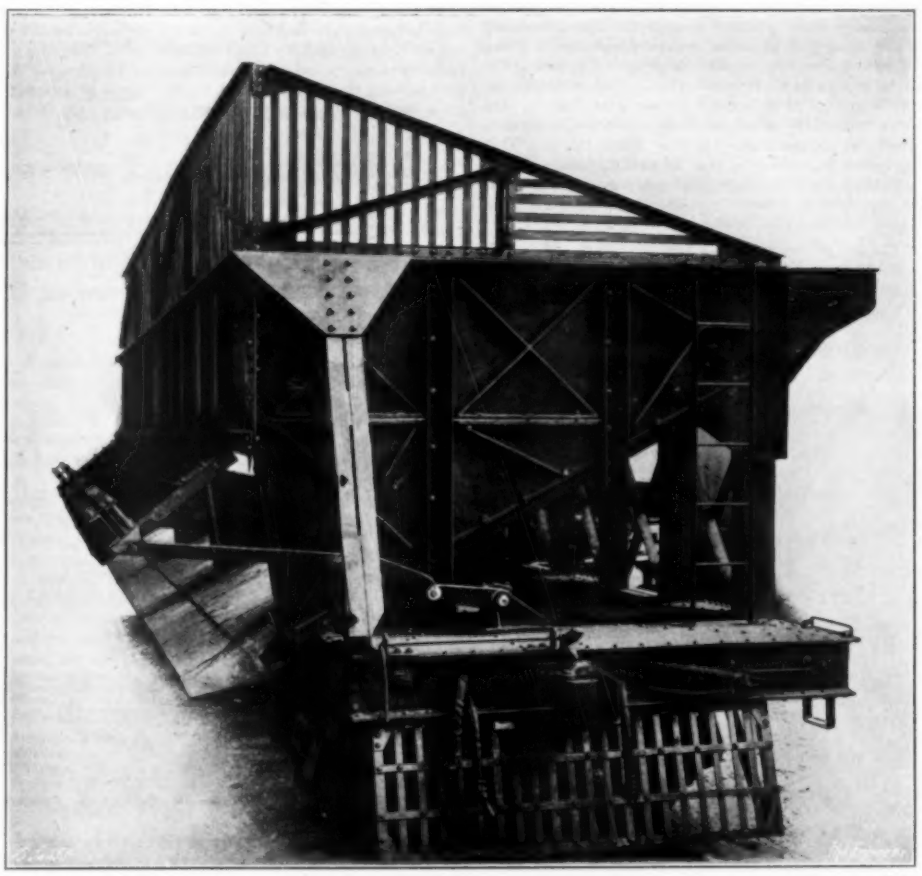


FIG. 17—COKE QUENCHING CAR

below. Incidentally, the jolting which the coke receives in traversing the discs effectively clears it of all fine dusty stuff.

The "throughs" from the grizzly—that is to say, all the stuff that is below 2½in. in size—drop to a double-decked "Perfex" screen—see Fig. 21. This screen is of the balanced type, which has been developed to overcome the objections to the old types of reciprocating, impact, vibrating, jigging, cascade and revolving or trommel screens. It is free from vibration, has a large capacity with small power consumption, gives effective screening on every square inch of its surface, and is robust and simple in construction. The screening surfaces are flat, of wire mesh which can be easily and quickly changed. The screening decks are attached by short-throw excentrics to two cross shafts which revolve at a high speed, causing the screen to travel in a circular orbit. These shafts are held in bearings attached to a cast iron frame. On the outer ends of the shafts are balance wheels counterweighted in opposition to the excentrics. This counterbalancing absorbs the vibrating forces of the screen within itself, so that no stresses are transmitted to the supporting structure other than the weight of the screen and the pull of the belt.

The output of the screen is very flexible. The sizes to be made may be quickly altered by changing the wire mesh decks, or one deck may be blanked entirely if fewer sizes are required. The peculiar motion of the "Perfex" screen gives a whip to the wire mesh deck that strongly agitates the coke, making a very clean

FIG. 18—COKE QUENCHING CAR AND LOCOMOTIVE

FIG. 19—MAIN CONVEYOR

oversize. The wire mesh screen on the upper deck has 2in. holes, and its oversize joins the oversize of the rotary grizzly on a short, transverse conveyor No. 2. The "throughs" from the upper deck drop to the lower deck of the screen. This lower deck is fitted with a wire mesh screen having ⅝in. holes. Its oversize drops down a chute to a wagon on the track below, and its "throughs," the breeze, drop to an 18in. wide belt conveyor No. 4, which carries them to the breeze bunkers or down a chute to wagons. This conveyor, which is illustrated in Fig. 24, is 146ft. long and has a rise of about 24ft. It will carry 25 tons an hour when running at a linear speed of 200ft. per minute. About halfway along its length there is a shoot which is served by a small bucket elevator from the ground level. This shoot is used to add to the breeze bunkers the breeze dredged out of the quenching water settling pond and any sweepings from the works in general.

Reverting to the drawing on page 192, it will be seen that the transverse conveyor No. 2 discharges on to another conveyor marked No. 3. This one is 36in. wide by 40ft. long, and its function is to load the coke into railway wagons with a minimum of breakage. For this reason the greater part of its length is supported on a hinged boom, so that its discharge end may be lowered into the railway wagon to reduce the fall of the coke, and, as the wagon fills, the conveyor is slowly raised.

We have now dealt with the two essential objects of the works—the production of coke and the recovery of by-products from the gas—and there only remain the power plant and its auxiliaries to describe.

THE POWER PLANT.

From Fig. 4 it will be seen that the by-products house and the engine-house are separated by a roadway and that the boilers are adjacent to the coke screening plant. There are four Babcock and Wilcox boilers, each capable of evaporating 12,000 lb. of water per hour at 160 lb. pressure and each having 3580 square feet of heating surface. The stokers are of the compartment type for forced draught and are operated by unit drives from separate motors. The fan is of the "Sirocco" type, direct connected to a motor of 42 horse-power, and the stack is of steel, 8ft. 9in. diameter by 125ft. high. The ash or clinker is dropped through shoots into cast iron water tanks fitted with paddle extractors, by which it is swept on to a 16in. rubber band collecting conveyor, and thence to an elevator for delivery into a concrete hopper over the sidings. The feed water for the boilers is heated in a Royles' heater and is supplied to the boilers by compound direct-acting pumps made by J. P. Hall and Sons. The boilers are fitted with an alternative means of firing with gas, and at the time of our visit were being worked in that way, as there was a considerable surplus of gas.

In the power-house, which is illustrated by Fig. 25, there are two main generating sets comprising Belliss and Morcom triple-expansion engines direct coupled to General Electric Company three-phase, 500 volts, 50 cycle alternators, each of 750 kW. The engines are of the three-crank three-cylinder vertical enclosed type working with forced lubrication. Each is capable of developing 1100 brake horse-power when supplied with steam at 140 lb. pressure superheated to a total temperature of 511 deg. Fah. and exhausting to a condenser with a vacuum of 26in. The engines, which run at a speed of 300 revolutions per minute, are also capable of 25 per cent. overload for two hours or longer period in case of emergency. The engines are fitted with automatic expansion gear operated through an oil relay. Provision is made for collecting any oil which may pass the packings at the casing top, or water which may drain down from the cylinder stuffing-boxes. This mixture of oil and water is led down by pipes into a receptacle in which the oil is separated from the water and returned to the crank chamber, the water being rejected to waste. The engine has cylinders 20in., 27in. and 43in. diameter with a stroke of piston of 16in., giving a piston speed of 800ft. per minute.

Each engine is connected to its own condenser of the Belliss jet type with a motor-driven rotary water extraction pump worked by a 30 horse-power motor and a two-stage steam air ejector. The condensing plants are designed to work in conjunction with cooling towers, the water extraction pump maintaining sufficient external pressure head for this purpose. The air ejectors have an intermediate condenser between the two stages. The pipe arrangement is such that either condensing plant can be used with either engine.

In the power-house there are two motor generators, seen in the foreground of Fig. 25, for supplying direct current. They are by the General Electric Company, are of 200 kW capacity and are driven by 288 H.P. motors. This direct-current supply is specially provided for the coke car locomotive, the coke pushers,

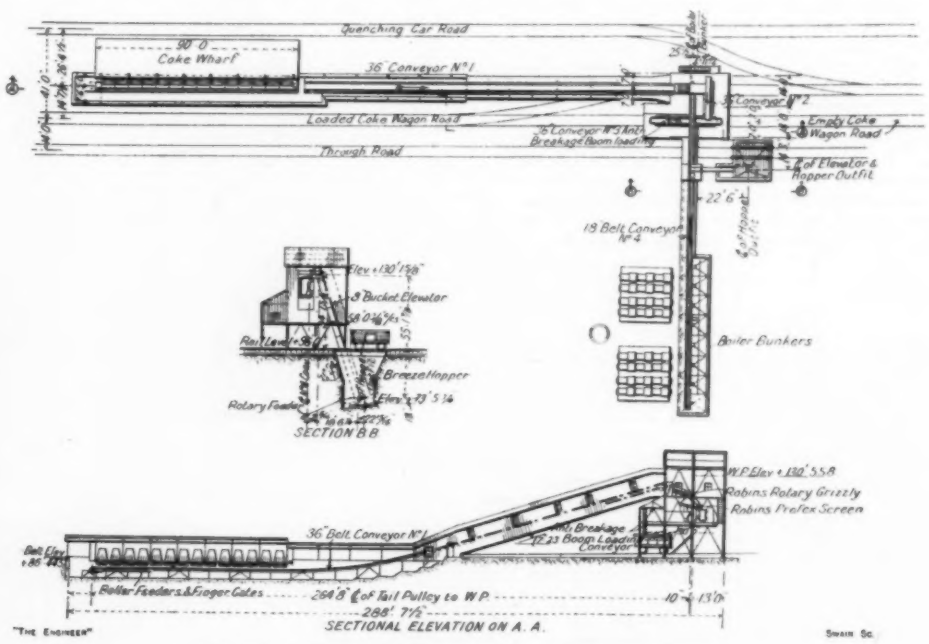


FIG. 20—GENERAL ARRANGEMENT OF COKE CONVEYORS

the reversing dampers and one or two other services, which are worked by direct-current motors on account of their large starting torques with small amounts of current. They are also more flexible as the speeds automatically adjust to the loads, while the controls and wiring are simplified.

The main switchboard, which is out of the view on the right of Fig. 25, is also of G.E.C. make. It is in two distinct sections, one for alternating current and the other for direct current. The alternating-current circuits are controlled by nine sheet steel cubicles with slate fronts, and three direct-current circuits by flat-back panels. On the alternating-

current side there are two panels for the generators, six 300-ampère feeders and an interconnection with the existing 1000-kW plant at the old chemical works. On the direct-current side there are two panels for the motor generators and one 800-ampère feeder.

At the far end of the power-house there are two exhausters for sucking the gas out of the main and delivering it to the recovery plant. One of them is shown in Fig. 26. These exhausters are of the Roots type, made by the Connersville Blower Company, of Indiana, and are capable of exhausting 524,000 cubic feet of gas per hour. Each exhauster is directly connected with a Belliss compound engine designed to run at 173 revolutions per minute and exert 85 brake horse-power with 140 lb. steam pressure when exhausting against 2 lb. gauge back pressure. These engines are of the maker's "C" type with high

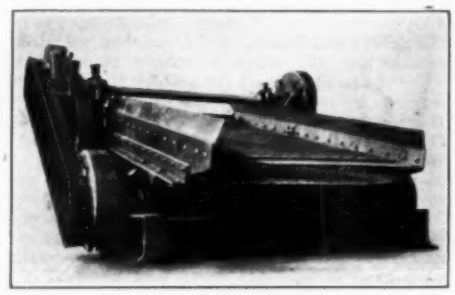


FIG. 21—"PERFEX" SCREEN

and low-pressure slide valves superimposed in the same valve chest and operated by the same excentric. The engine throttles are controlled by a Bryan Donkin governor coupled up to the gas collecting main at the ovens. The exhaust from these engines is used for boiler feed heating purposes.

The cooling water from the condensers of the main engines and that circulating through the gas coolers is cooled in two separate sets of towers, by the Premier Cooler and Engineering Company, of Shalford, near Guildford. Each of these towers is capable of dealing with 60,000 gallons of water per hour and reducing its temperature from 130 deg. Fah. to about 70 deg. Fah. when the humidity of the atmosphere is about 75 per cent. The framework of the towers is of pitch pine, while the rest of the material is red deal. All the timber was treated with creosote by the vacuum pressure system. The principle of the

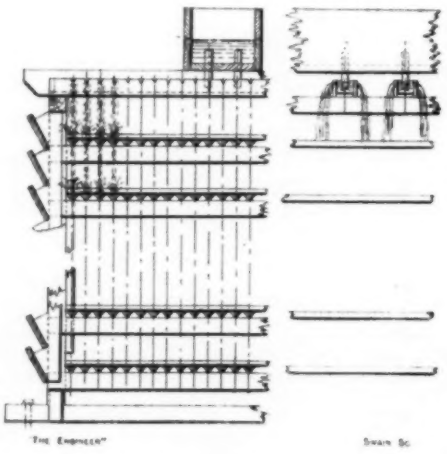


FIG. 22—COOLING TOWER

Premier cooler can be followed in the sketch Fig. 22. The hot water is pumped up into overhead troughs, through the bottom of which it escapes by means of short lengths of vertical piping. These pipes feed transverse troughs below and can be adjusted as to their distance below the water line in the main trough, so as to distribute the flow evenly in the transverse troughs. These troughs have notches in their edges, and the water overflows at these points to splash on to V-shaped laths below. The layers of laths are so arranged that the drippings from the apex of one lath fall on to the centre of the one below, and the water is consequently broken up into a fine rain, which is cooled by partial evaporation. Round the sides of the tower there are arranged louvre boards to admit a draught of air.

Among the other sub-contractors who helped towards the completion of this fine plant there were the Pulsometer Engineering Company, of Reading; and Sulzer Bros., of 31, Bedford-square, London, W.C. 1, who supplied a number of centrifugal pumps for various purposes. The whole contract was carried out by the Semet Solvay and Piette Coke Oven Company, Ltd., to the order of the South Yorkshire Chemical Works, Ltd.; the lay-out and details being to the requirements of the general manager, Mr. G. A. Hebden, to whom we are greatly indebted for the facilities for preparing this article.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAILWAY BREAKDOWN EQUIPMENT AND WORK.

SIR,—In view of the article on "Railway Breakdown Equipment and Work," which appeared in your issue of July 27th last, and of the subsequent correspondence on the subject in your columns, I think that perhaps the following account of the re-railing of a locomotive may be of interest to your readers:—

A locomotive had become displaced from the railway, owing to the carelessness of the driver. The writer was called upon to get the engine back on the rails as quickly as possible. What had occurred and the position, was as follows:—A heavy 2-6-0 freight locomotive was being run off a turntable—tender first—but failed to take the facing road, with the result that the end wheels became derailed, as indicated in the end view sketch—Fig. 1.

It so happened that the usual breakdown gang was engaged on an important job elsewhere, and as only a 50-ton hydraulic jack was available in the shed, it will be apparent to readers associated with railway work that something of a problem presented itself. It was intensified when it became known that the derailment was holding up or obstructing the whole coaling road.

However, the locomotive was got into position once again within 20 minutes, and the method adopted, without any assistance beyond that of the hydraulic jack, is described for the benefit of others who may find this method useful. Referring again to Fig. 1. A piece of hard

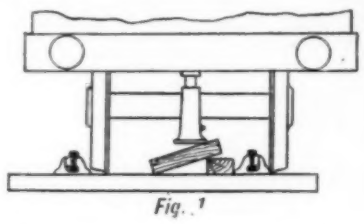


Fig. 1

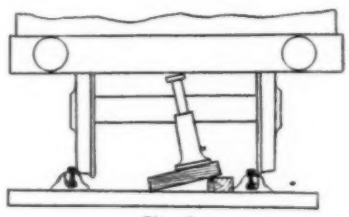
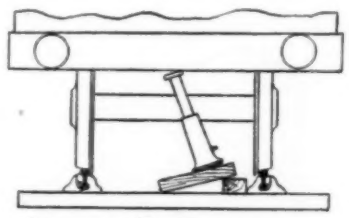


Fig. 2



"THE ENGINEER" Fig. 3

wood packing was placed lengthwise to the rails and another piece laid down, so that one side rested against the sleeper, the uppermost timber being aslant. The jack was placed on this with its top end central to the framework of the engine. As the jack started to lift, it naturally heeled over to the packing block, thereby giving side as well as upward movement to the locomotive, as clearly seen in Fig. 2. When the wheels were level with the top of the rail, the jack tilted even more, and in so doing lowered the wheels to the rails, as seen at Fig. 3.

It should be mentioned that a mixture of water and sand applied to the top of the jack prevented it from slipping while tilting over.

This method of re-railing has been adopted on several occasions, and is particularly useful in such positions as sidings, alongside platforms, on a bridge or wherever it is impossible to employ a crane or ramps. De-railed wagons also can be very quickly righted, without even withdrawing any other nearby vehicles.

August, 20th. E. M. H. S.

FIFTY-PERIOD SINGLE-PHASE ALTERNATING CURRENT FOR RAILWAY TRACTION.

SIR,—Mr. Geo. T. Pardoe, in your issue of the 17th inst., states that he does not think that I would suggest that the same amount of electrical energy could be transmitted, without increasing the value of the current, at 100 volts as compared with 200 volts. I quite agree with him, he has certainly misread or understood my meaning; but what I will very clearly state is that by means of the new single-phase alternating railway traction system it is now possible to handle at least three times the tonnage in a given period of time, or according to given schedule, than is possible with the present type of continuous or alternating-current traction systems in operation, at least as far as I have seen in many parts of Europe.

In reference to his remarks concerning mercury arc rectifiers, may I state that those have been tried on the Paris Railways, and also on the Midi Railway in France; in the case of the Parisian Tramways the rectifiers deliver 600-volt direct current and in the case of the Midi Railway 1500 volts. The rectifier has a certain advantage that it can take in alternating current at, say, 25 or 60 periods, making the running of locomotives possible over roads which are electrified at different frequencies.

In bringing out the new "Paragon" single-phase alternating-current traction system I can assure Mr. Pardoe that a very wide view has been taken, and it is the inventor's opinion that the future of commercially paying railway electrification for trunk or main lines must now be confined to standardised 50-period single-phase alternating-current general distribution, and that the proper use of the Grid, which will ultimately be formed by the Government scheme, will result in enormous saving in the cost of electrifying existing railway tracks, and that it is a very great mistake to continue the installation of the complicated and less efficient three-phase system as is generally being proposed.

I am well aware that the single-phase alternating-current traction system, in the past, has not given such all-round satisfactory results as many of the continuous-current ones; but that is a matter of design and construction, and such installations put up in this country many years ago cannot be expected to be able to compete with modern practice and based on modern research work.

Before the main line railways can possibly be commercially electrified it is essential to have unification and a standard system to operate on. The direct-current system for trunk line operation is commercially impossible, as is well known and has been proved, particularly during the last few years; so why inflict on the country a system of generation and distribution which is physically impossible, such as three-phase alternating-current supply. The only alternative is single-phase, so why not have it in the first instance and not to be driven to it in the end?

Mr. Pardoe's remarks concerning the private installation aspects are full of interest. I know of one large colliery in the North of England which recently, owing to the supply cables giving out, had all its motors stopped, and the mine was flooded and a very considerable inconvenience was caused in other directions. Such happenings are certainly not going to bring about much confidence in the Government scheme unless some proper stand-by of a commercial nature can be secured. By the proper use of this new system such a total pull-up would be practically impossible.

The great problems before the Government and the railways, together with the country generally, are how to bring about more efficient, more economical and more expeditious methods of handling transport, and how to serve the people of the farms and cities in the most satisfactory manner, and I maintain that this will only be secured by the cheaper and more efficient single-phase alternating-current general supply. It is for that reason I am of the opinion that THE ENGINEER, in its leading articles recently, has opened up a field of the utmost significance. WILLIAM P. DURTNALL,

Captain, M.I. Loco. E.

Westminster, London, S.W. 1, August 22nd.

BRINELL AND HERTZIAN HARDNESS.

SIR,—In your issue of August 14th, page 180, certain Brinell hardness figures—second table in column 3—quoted by M. Esnault-Pelterie, appear to be somewhat misleading. The figures are stated to be the Brinell hardness of a quenched manganese-silicon steel in kilogrammes per square millimetre. Reference to the original experiments—R. P. Devries, "Proc." Amer. Soc. Testing Materials, 1913, 13, 550, and International Tables, Vol. 4, Part 2, p. 1351, &c.—shows that the figures quoted are the loads in kilogrammes which were required to produce impressions 0·1 mm. deep when a 10 mm. diameter steel ball was pressed against the surfaces of the materials, and not contact pressures in kilogrammes per square millimetre.

The Brinell number of a quenched steel of the composition given would be about 750, and not of the order of 3000, as stated by your contributor. Accordingly, the comparison of the latter figure with the results of Auerbach's experiments is invalid, although M. Esnault-Pelterie's conclusion that "the Brinell method measures something which differs from the elastic limit" is not disputed. G. A. HANKINS.

Teddington, August 20th.

AMONG the many railway stations which have been reconstructed in France since the end of the war, the passenger station at Lens is of particular interest, because of its having been built on ground which is definitely known to be unstable, owing to extensive mine workings below the site. Records show that during the past fifty years an average yearly settlement of 4in. has taken place. To provide a structure which would not be destroyed by settlement, and which could be lifted to its correct level, reinforced concrete has been employed. The structure, which has the appearance of one complete unit, is, in fact, built in eleven sections, each section being on a foundation of parallel inverted arches which transfer the weight directly to the ground. Any section is free to settle approximately 10in. without affecting adjacent sections in any way, and any section can be raised within that limit when necessary. At the four corners of each section space is left for one or more heavy jacks. The jacks will be used only long enough to permit filling in under the arches, and as soon as that is done the weight will be returned to the usual foundations until raising is again necessary.

G

Apparatus and Methods for Measurement of the Hertzian Hardness.*

By R. ESNAULT-PELTERIE.

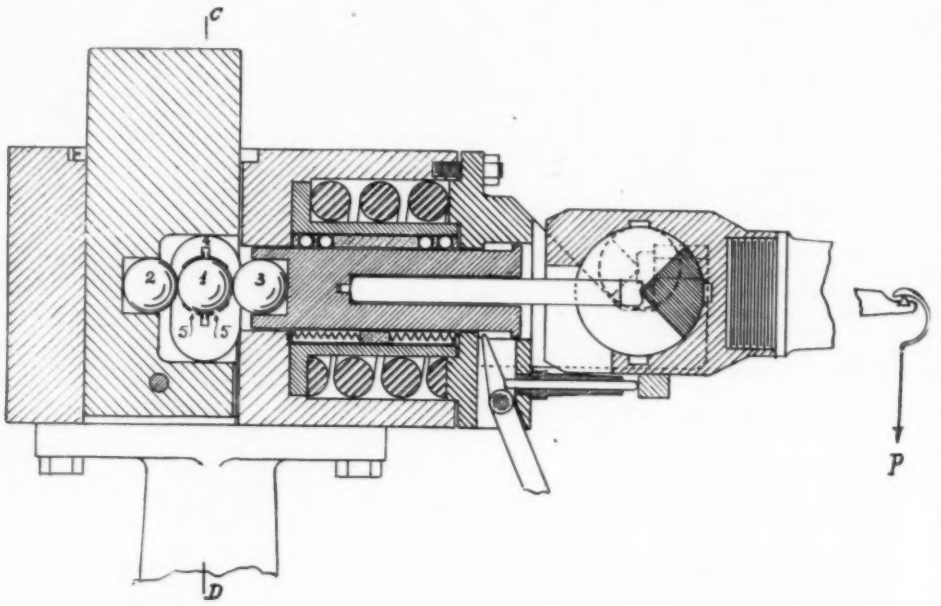
(*Continued from page* 181.)

METHOD OF MEASUREMENT.

(1) *Measurement of the Frictional Moment.*—The ball 1 of the material under test is arranged between two equal balls 2 and 3—Figs. 2 and 3. The ball 1 is rigidly held by a light beam 4, which carries a scale pan in each of its extremities. The weight on one of the scale pans is increased gradually until equilibrium is destroyed. If P represents the weight on the scale pan and a the length of the corresponding lever arm, the moment τ is given by $\tau = a\,P$. The accuracy necessary in the measurement of friction requires complete absence of any intermediate lever between the ends of the beam and the weights for measuring the moment, and consequently the author found it necessary to arrange the axis of alignment of the balls horizontally.

(2) *Measurement of Hardness; Rendering Visible the Diameter of the Surface of Contact.*—In order to render visible the diameter d of equations (1), (1A), (2), (3) and (5), the ball 3 is covered with a coating that will disappear on the whole area over which contact takes place. The ball is then moved into the field of a microscope, having a micrometer eyepiece, or preferably with cross-hairs which can be moved by a micrometer screw and by which the diameter of the circular mark which appears black on a light background can be measured with precision. In order to increase the contrast between the portion from which the coating has disappeared and the rest of the surface, tangential illumination is used.

After a large number of trials, the process that appeared to give the best results was that of silver plating the balls, and sulphiding the thin silver coating as a means of making the surface of contact visible.



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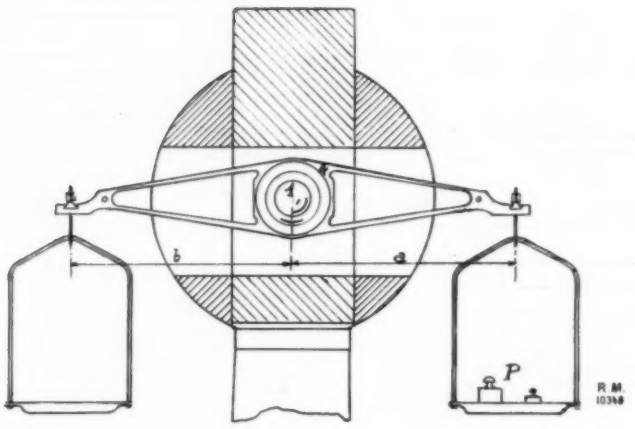


FIGS. 2 AND 3

(3) *Measurement of the Pressure on the Balls.*—The arrangement of the apparatus, which must enable not only the diameter of the circle of contact to be measured, but also the frictional moment to be ascertained, required, as already explained, an arrangement of the axes of the balls in horizontal alignment.

From the commencement of this research, the author had naturally considered a method for exerting the pressure on the balls by the action of a lever, but in this case it would have been necessary to arrange the axis of alignment of the ball vertically, for it appeared impossible to measure the ratio of the lever arms sufficiently accurately, as these would have required to be arranged at right angles and to operate through knife-edges.

The solution to this difficulty was only found later by an arrangement of the knife-edges on a single piece of metal accurately fitted into a cylindrical housing. Two preliminary measurements made with three knife-edges in line gave two simultaneous equations, from which it was possible to obtain the exact ratio between the arms of the lever by elimination.

The cylindrical block was then turned through 90° and the arrangement of the three knife-edges was then at right angles, as required.

The fitting of the cylinder in the housing can be effected to a thousandth of a millimetre (0·00004in.), and the error introduced by this on the long arm, which is 500 mm. in length, is absolutely negligible.

Description of the Apparatus.—The apparatus for applying pressure to the balls—shown in Fig. 4—consists of a lever 20 with arms at right angles, carrying three knife-edges. The sulphur-treated ball 1 is held in a strong cylindrical piece 17, capable of turning about a vertical axis and acting as a key, which is secured in a definite position by a locking pin 18 fitting without play.

After each application of pressure it is possible, by means of a hand lever 19 to raise the lever 20 carrying the weight by acting on the small collar 21 of the cylindrical piece forming the housing 22 of the ball 2, which thus moves back itself out of contact with the ball 1.

The cylindrical locking pin 18 is then withdrawn from the key 17, which is turned through 180° The key 18 is replaced and the ball 1 is then presented in the field of the microscope 23 attached to the base of the apparatus.

The mark left in the very thin sulphide coating is lighted tangentially through the passage 24, and appears in the field of the microscope as a black circle on a grey background, the edge being sharply defined when the silvering or the coppering is sufficiently thin and well made.

When the reading has been taken, the operations are repeated in opposite order and the ball 1 is returned exactly into the place that it occupied in front of the ball 2, so that successive applications of pressure may be made without changing the point of contact of the ball 1 for each new load. In the first apparatus designed by the author this operation was slow and troublesome.

The examination by microscope of the sulphided coating permits the same impression to be measured on several diameters, and this enables a mean to be obtained and greater accuracy to be ensured.

Results: Variation of the Diameter d of the Circle of Contact as a Function of the Load F.—The author first endeavoured to obtain a verification of the law of the diameter d of the impression as a function of the load F for which Hertz's theory gives the formula

$$d^3 = \frac{5{\cdot}46\ \mathrm{F\,R}}{\mathcal{E}} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

The experiments were made on bearing balls, 20 mm. in diameter, and Table I. gives the results

TABLE I.

F.	d measured.	d calculated.	$\mathcal{E}$ in kg./cm.²
25	0·400	0·401	$2{\cdot}133\times10^6$
30	0·424	0·426	2·149
35	0·446	0·449	2·153
40	0·469	0·469	2·115
45	0·491	0·488	2·075
50	0·505	0·506	2·120
55	0·523	0·522	2·097
60	0·543	0·537	2·045
65	0·545	0·552	2·193
70	0·557	0·565	2·213
75	0·572	—	2·188
80	0·584	—	2·193
90	0·602	—	2·252
100	0·622	—	2·272
110	0·663	—	2·060
120	0·693	—	1·967
130	0·703	—	2·043
140	0·727	—	1·989
150	0·747	—	1·964
160	0·766	—	1·944

corresponding to a series of measurements made on the same ball. The curve—Fig. 5—was obtained by plotting the loads F as abscissæ and the diameter d of the circle of contact as ordinates.

Measurements made on November 16th, 1925.—By comparison between the values obtained by experiment and those calculated, it was found that Hertz's law is verified to a perfectly satisfactory degree of approximation for values of load F less than 60 kilos.; beyond this the elastic limit of the steel is exceeded,

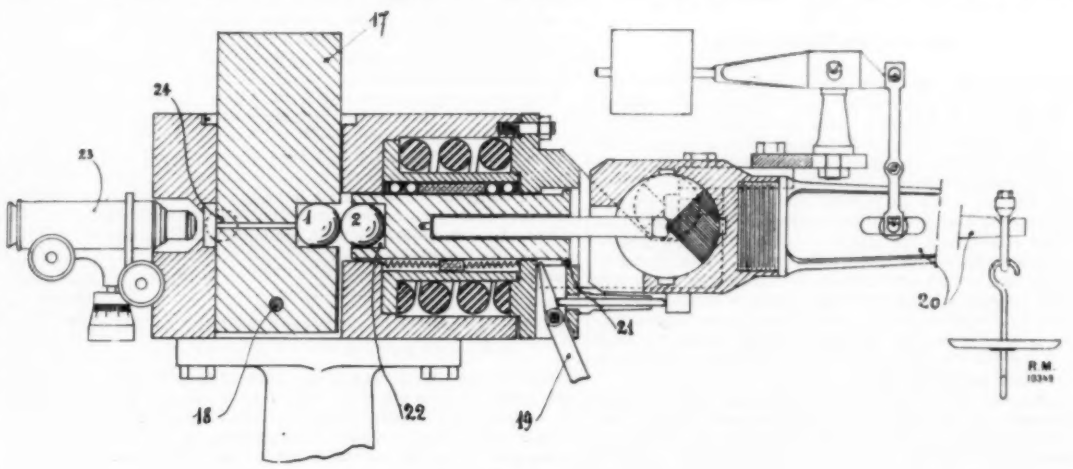


FIG. 4

and the deviations become rather pronounced, the curve forming a series of festoons with cusps A B C. The first of these fall remarkably closely on the continuation of Hertz's curve that precedes the elastic limit—Fig. 5.

For the elastic limit of this steel the formula (2) gives the stress at the centre of the circle of contact—

$$F_{max} = 388 \text{ kg./mm.}^2 \quad . \quad . \quad . \quad . \quad (9)$$

It should be noted that if we take the mean value of $\mathcal{E}$—see equation (10)—for the eight first measurements that fall within the elastic limit, we obtain the figure $2 \cdot 111 \times 10^6$ kg./cm.^{2}.

Now, according to Bouasse, the $\mathcal{E}$ of Hertz's

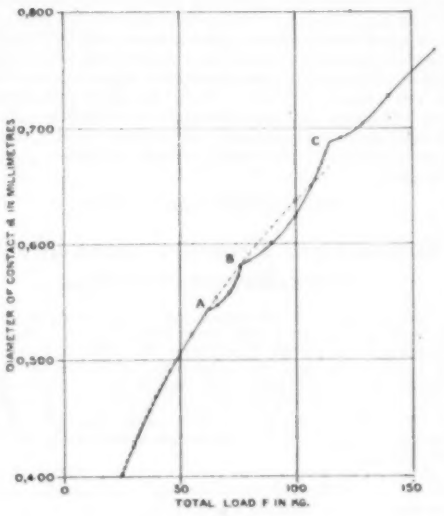


FIG. 5

formulæ bears the relation to Young's modulus E given by the equation

$$\frac{1}{\mathcal{E}} = \frac{1 - \sigma^2}{E} \quad . \quad . \quad . \quad . \quad (10)$$

According to the Tables of Physical Constants, Table 47*c*, steel has very widely differing characteristics—

$$0 \cdot 25 < \sigma < 0 \cdot 33 \quad . \quad . \quad . \quad . \quad (11)$$

and according to the formulæ of Table 47*a* of the above-mentioned physical constants—

$$\mu = \frac{E}{2(1+\sigma)}^{*} \text{ and } c = \frac{E}{3(1-2\sigma)} \quad . \quad . \quad (12)$$

That is—

$$\frac{c}{\mu} = \frac{2(1+\sigma)}{3(1-2\sigma)} \quad . \quad . \quad . \quad . \quad (13)$$

Hence, according to the values given in Table 47*c* for ordinary steel

$$\frac{c}{\mu} = \frac{16{,}000}{8{,}000} = 2 \quad . \quad . \quad . \quad (14$$

whence

$$\sigma = 0 \cdot 286 \quad . \quad . \quad . \quad . \quad . \quad (15)$$

We have therefore—

$$E = 0 \cdot 918 \, . \, \mathcal{E} = 0 \cdot 918 \times 2 \cdot 111 \times 10^6 = 1 \cdot 938 \times 10^6 \text{ kg./mm.}^2 \quad . \quad (16)$$

This figure agrees very well with the values given for hardened or treated steels, as well as with the figure given by Colonel Lafay in his paper, page 21—

$$E = 1 \cdot 950 \times 10^6 \text{ kg./cm.}^2 \quad . \quad . \quad (17)$$

TABLE II.—*Measurements Made with Balls of the Same Quality in July*, 1926.

F.	*d* measured.	*d* measured, as given in Table I.
25	0·424	0·400
30	0·434	0·424
35	0·448	0·446
40	0·466	0·469
45	0·485	0·491
50	0·507	0·505
55	0·527	0·523
60	0·542	0·543
65	0·551	0·545
70	0·572	0·557
75	0·583	0·572

These results confirm in an interesting manner the accuracy of which this method is capable and the deviations that it shows.

The two first values of *d* under the lightest loads are much larger than those Hertz's law would give, and larger than those obtained on November 16th, 1925. This phenomenon had also been observed in the measurements made on November 7th, 1925—Fig. 6.

For a total load exceeding 35 kilos. the measurements made a few days before agreed within 1 per cent. with those that had been made eight months before; that is, up to a total load of 60 kilos., at which the deviation is shown by festoons similar to those of the old trials and with the same features that the cusps at the ends of the festoons, or at least those at the ends of the first festoon, lie on the continuation of Hertz's curve.

Tests made July 4th, 1926: Balls 20 mm. Diameter, of a different Manufacture.—Table III. gives two series of measurements made with these balls.

The second series follows Hertz's curve fairly closely, and the first series deviated appreciably by falling below at the start, but, as in the previous

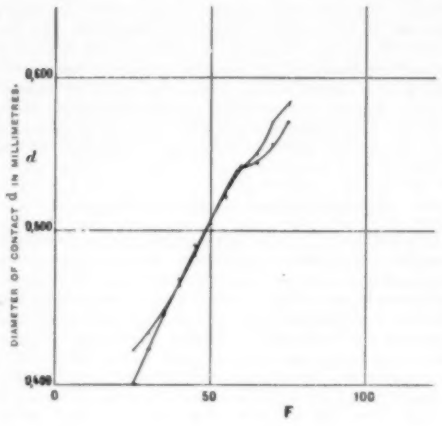


FIG. 6

instances, the two curves coincide at a total load of 40 kilos.—Fig. 7.

Above 50 kilos. the curves, running close together,

TABLE III.

F.	d_1.	d_2.
25	0·414	0·418
30	0·428	0·438
35	0·451	0·461
40	5·480	0·480
45	0·503	0·501
50	0·521	0·519
55	0·534	0·537
60	0·543	0·543
65	0·561	0·566
70	0·576	0·586
75	0·586	0·602
80	0·608	0·619
85	0·612	0·619
90	0·622	0·638
95	0·628	0·646

show the peculiarity of deviation below Hertz's curve, and both show clearly the breaking point at 60 kilos., as in the balls previously tested, although of different manufacture.

Tests on Nitrogen-treated Special Steel.—The following three trials were made on balls 20 mm. diameter, manufactured from special steel supplied by Messrs. Aubert and Duval and nitrogen treated—see Table IV.

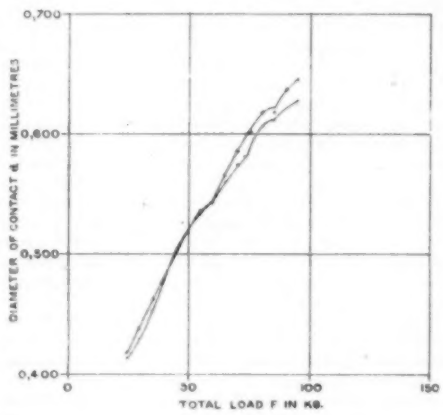


FIG. 7

TABLE IV.

F.	d_1.	d_2.	d_3.
25	0·398	0·395	0·400
30	0·422	0·419	0·430
35	0·444	0·446	0·461
40	0·463	0·462	0·480
45	0·485	0·484	0·498
50	0·503	0·502	0·517
55	0·525	0·507	0·538
60	0·556	0·525	0·551
65	0·552	0·539	0·566
70	0·580	0·559	0·581
75	0·596	0·565	0·594
80	0·601	0·581	0·607
85	0·611	0·598	0·620
90	0·628	0·605	0·627
95	0·645	0·618	0·675
100	0·646	0·625	0·685
105	0·658	0·636	—
110	0·670	0·645	—
115	0·680	0·663	—
120	0·685	0·666	—
125	0·696	0·682	—

Trial No. I appeared to show that the breaking stress occurred with a load of 75 kilos., but as the sulphide coating was not as good as might be desired and as the points corresponding to 60 kilos. and 65 kilos. show, in relation to the curve for the other loads, errors that are at least equal to those at the points for 80 kilos. and 85 kilos. These observations should be treated at present as of doubtful value.

Curve No. II shows a phenomenon which the author had already observed by accident. At loads above 50 kilos. the curve drops as a whole, and does not give a definite indication of the limit of elasticity. The cause of such occasional anomaly was only discovered later.

Curve No. III appears to show very clearly that the breaking stress occurs at 90 kilos.—see Fig. 8.

Measurement of the Coefficient of Friction.—The magnitude of the coefficient of friction can be deduced,

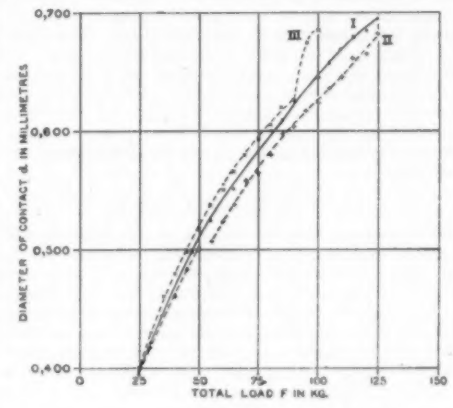


FIG. 8

as has been shown, from the moment of friction by means of the formula

$$\mu = 3 \cdot 394 \frac{\tau}{F\,d} \quad . \quad . \quad . \quad . \quad . \quad (18)$$

The measurements made on balls of steel of good commercial quality have given the following results—see Table V.

TABLE V.

F.	*d*.	τ.	μ.
25	0·400	0·0215	0·073
30	0·424	0·027	0·072
40	0·469	0·042	0·076
50	0·505	0·0545	0·073
60	0·543	0·073	0·076
70	0·557	0·090	0·078
80	0·584	0·1085	0·079
90	0·602	0·1300	0·081
100	0·622	0·1525	0·083

Disadvantages Inherent to the First Method.—The silver coating deposited on one of the balls used for making the circle of contact visible must be extremely thin, otherwise it is crushed over a larger area than that of the actual circle of contact, and the measurements of its diameter are subjected in all cases to a positive error, which is by no means negligible.

As mentioned above, the properties of the surface of solids commence to be altered by the addition of a layer of another body having a thickness of 50 $\mu\mu$. This applies to the optical properties as well as to the others, so that a layer of thickness 50 $\mu\mu$ on the surface of a polished ball is sufficient to allow the circle of contact to become visible.

It is possible to obtain a layer the thickness of which is not much greater than this by stopping the silver plating as soon as the reflecting power of the surface of the glass vessel in which the operation is being performed is observed to increase.

In this respect conditions are very nearly as favourable as those of Hertz's experiments in which he used interference rings, the ill-defined border of the surface of contact corresponding in his case to the difference of the radii of the actual circle of contact and of the circumference of the circle separated from the other by one-quarter of the wave length of the light used; that is to say, of the order of magnitude of 10^{-3} cm.

Unfortunately, the successful production of so thin a film depends on an operation that is extremely delicate, and that gives a successful coating only rarely. The author found, moreover, that he had to make numerous measurements on the new steels submitted by Messrs. Aubert and Duval, and in this case the specimen balls machined from a test bar in small number were neither perfectly spherical nor perfectly polished. The area of contact as it appears in the field of the microscope is consequently often far from being circular.

(To be continued.)

* In the tables referred to this μ represents the Coulomb's modulus.

Steam and Fuel Economy Devices on American Locomotives.

IN addition to improvements in the machinery and general design of American locomotives, such as have been described in the recent series of articles on "The General Development of the Locomotive," in THE ENGINEER, there is a continual development in devices and appliances intended to improve the steam production and distribution and the fuel economy. A number of such devices were described at the annual meeting of the American Railway Fuel Association, and a brief review of some of these devices is given herewith. It may be noted that while some of them are in the earlier or advanced stages of experimental trial, others are already in extensive use in regular service.

CAST STEEL ASHPANS.

Since early trials beginning about 1919, the use of cast steel in place of the usual steel plate construction

for ashpans has extended to forty-two railways, with an aggregate number of 5649 locomotives thus equipped. While the weight is about doubled, and the cost rather more than 50 per cent. greater, it is the almost universal opinion that these disdavantages are much more than offset by the decreased cost of maintenance and the increased life. Their life can only be estimated as yet, but it is expected to be six or more times that of steel plate ashpans, while one railway estimates it as at least ten years. The thickness of metal in the body is usually about $\frac{5}{16}$in. On some lines the cast steel ashpans do not warp as readily as the others, but where such warping has occurred—owing to local heating—it has been remedied by the use of small liner plates. About 364 cast steel ashpans are in use on oil-burning locomotives.

Cast Steel Smoke-boxes.

To overcome the difficulties of keeping smoke-boxes air-tight and of preventing corrosion of the shell and interior parts and fastenings, a cast steel smoke-box was devised on the New York, New Haven and Hartford Railroad. As a result of a year's service, on a 4–6–2 passenger engine, the same design has been applied to twenty 4–8–2 goods engines and six three-cylinder shunting engines. The shell or body is cylindrical to just ahead of the chimney, and is then curved inward like a circumferential segment of a hemisphere to the door ring, the size of door being governed by the minimum diameter of opening necessary for the removal of the lower tubes. This curved form of front end avoids the usual bottom corner where cinders collect, and—if kept alive by air leaks—gradually burn out the bottom of the shell and door. The cast steel is also less subject to abrasion by the cinders impinging upon it. Such exterior parts as steps, brackets for feed-water heaters, lugs for smoke-box braces to the frames, flanges for steam pipes, supports for outside regulator valves, and hinges for the door, are all formed as integral parts of the casting. Grooved ribs on the inside provide attachment for the deflector plates, and the panels of spark arrester netting. These parts are fitted tight by means of asbestos strips in the grooves and are secured by taper keys driven in lugs formed on the casting.

Draught-equalising Grates.

As a result of experiments undertaken to equalise the intensity of draught over the entire area of the fire-box, the Saint Louis–San Francisco Railroad has equipped about a dozen large goods engines with grates in which the front part has openings aggregating 35 per cent. of its area, while in the rear part these openings aggregate only 25 per cent. of the area. Formerly, the 35 per cent. proportion applied to the entire grate, but tests showed that there was a variation of 30 per cent. in intensity of draught at the front and rear portions of the grate. In firing, the practice was to bank the coal at the rear of the grate, but with the new design a thin and level fire can be carried over the entire grate. This arrangement promotes good combustion and fuel economy, and also reduces the cinder losses which occur with high draught intensity concentrated at individual parts of the fire bed.

Forced Draught for Locomotives.

Of special interest is a locomotive of the Texas and Pacific Railroad, which has forced draught delivered to a closed ashpan. In other attempts to eliminate the back pressure which is due to the restricted area of the ordinary blast-pipe or nozzle, several devices have been tried for producing an induced draught by means of a fan mounted in the smoke-box. Owing to the difficulties incident to handling the great volume of hot gas and the abrasive action of the cinders passing through the fan, none of these attempts have got beyond the experimental stage. But in the present experiment a forced draught is produced by a fan discharging cold air into a closed ashpan and fire-box, with promising results. The engine is of the 2–10–2 class, having cylinders 28in. by 32in., and carrying 200 lb. boiler pressure. A steam turbine fan unit, discharging 34,000 cubic feet of air per minute at 7in. of water pressure, is placed on the left side, just over the main driving wheel. The current of air is led through a sheet iron duct to the fire-box, the bottom of the ashpan being extended to form the bottom of the duct, while on the inner side is an opening, 10in. high, beneath the foundation ring and extending the full length of the fire-box, about 14ft. The ashpan is of cast steel, and so designed as to be both water-tight and air-tight at the draught pressure. The force of draught is controlled by varying the speed of the fan.

In the smoke-box, the usual spark deflector plates and spark arrestor netting are omitted. The blast-pipe has an opening 9in. in diameter on a 10in. pipe, in which is a helical deflector to give a whirling motion to the jet of steam and thus expand it to a larger diameter than would be attained by simple expansion. In ordinary equipment for locomotives of this size, the blast nozzle is 6¾in. to 7¼in. in diameter, so that the nozzle on the forced draught engine has an area 1½ to 2 times greater. The funnel is 39in. in diameter at the throat, with a cross-sectional area greater than the combined area of the tubes, so that the gases escape without check or restriction.

As the centrifugal force of the whirling exhaust steam tended to scatter the dust and cinders and shower them around the cab, the top of the chimney is now fitted with curved vanes or deflectors, which throw the cinders back into the centre of the jet, but which offer little resistance to the passage of the steam. A mechanical stoker is used, and the engine has run 25,000 miles without trouble with the fire. When the fan is in operation, the fire-door cannot be opened for hand firing, even in a case of emergency. This door is closed with a screw clamp, to be removed only for repair or overhauling with the engine out of service. The shaking grate has an area of 67 square feet, of which the air openings represent 19 per cent.

New Forms of Blast-pipes.

Besides the very large blast-pipe used on the forced draught locomotive described above, some other special designs are in experimental use. The Layden blast-nozzle, which is set very low in the smoke-box, has four openings at the ends of the arms of a cross. The exhaust from each cylinder is divided into two jets, those from one cylinder being in the longitudinal centre line of the engine, and those from the other cylinder in a line at right angles to this. The design is such that the exhaust from one cylinder cannot cross over and create a back pressure on the other cylinder. The avoidance of this back pressure, which is of general occurrence ordinarily effects a saving in fuel and an increase in hauling capacity. Owing to the wide spread of the jets, a funnel of large diameter is used, which gives a lower velocity of escape for the products of combustion, and also reduces the back pressure on the cylinders. At the centre of the blast-pipe, or at the centre of the cross, is a small nozzle for the blower jet.

In the Oatley blast-pipe, which also is set low in the smoke-box, the opening is a long narrow slot, about 1¾in. wide and 26in. long, in the longitudinal centre line of the engine. Its area is about 35 square inches. To conform to this peculiar form of jet the funnel is of flattened section, long and narrow in plan.

Steam Distribution Devices.

Of devices intended to effect economy by improved distribution of the steam, the Duplex piston slide valve is designed for restricted cut-off and to give economy in steam consumption by taking from the boiler at each stroke only the minimum amount of steam required to develop the necessary cylinder power. The back pressure is kept at a minimum by the use of exhaust ports of adequate capacity. An auxilary port in the valve provides for additional or auxiliary steam admission to insure reliability in starting.

An earlier device for mechanical control of cut-off has been improved by the addition of a converter valve, giving a more accurate control of back pressure. This device is the development of a syphon, having one side connected to the exhaust cavity and the other side—of equal area—supplied with air from the reducing valve pipe of the air brake system. Increased pressure in the exhaust cavity causes a diaphragm to displace and thus shift a slide valve, admitting air into the chamber until the pressure is equalised, when the slide valve moves back to its closed position. With reduction of pressure in the exhaust cavity, the slide valve is moved in the opposite direction, allowing air to escape from the chamber until pressure is again equalised.

Trials of a steam desaturator indicate that there is a field for this device. In operation, its centrifugal action has separated water from steam at the regulator at the rate of 500 lb. to 1150 lb. of water per hour, this water being returned to the boiler at boiler temperature. For an engine mileage of 3000 miles per month the saving in coal would be about 8000 lb. per month.

A combined speed indicator and cut-off indicator, with automatic record of each function, has been tried on the New York Central Railroad, and found to effect an 8 per cent. saving in coal per 1000 gross ton-miles per train-hour. On the basis of the same coal consumption with and without this device, there would be in the former case an increase of 14 per cent. in 1000 gross ton-miles per train-hour. The speed element is of the centrifugal type, chain driven from a friction wheel riding against the tread of the main driving wheel. A red pointer on a dial indicates the speed, and a white pointer on the same dial indicates the percentage of cut-off. Maximum economy in operation is obtained when the white pointer is as far in advance of the red pointer as operating conditions will warrant.

Feed-water Heaters.

About 5437 locomotives are fitted with feed-water heaters, of which 4918 are of the pump type, the others being of the injector type. The latest development comprises a vertical steam turbine driving a two-stage centrifugal pump. Steam entering through a nozzle passes through the buckets of the turbine wheel, and is then returned by another nozzle for a secondary passage through the wheel. Exhaust steam passes into the heater. Feed water flows to the impeller of the first stage of the pump, and is delivered to the second stage at half the final delivery pressure. This second stage then raises the pressure to that required for delivering it to the feed-water heater.

Direct Steaming at Engine-houses.

Another line of fuel economy is in steaming up engines at the running shed or engine-house by means of a stationary boiler plant, instead of by a fire in the engine fire-box. With this arrangement steam is generated much more economically, and often with a cheaper grade of fuel, while the smoke and dirt from firing up in the shed are avoided. Large goods engines of the 2–10–4 class, with boilers of 5000 gallons capacity, on the Texas and Pacific Railroad, can be steamed to 150 lb. pressure in 45 minutes, including the time required to fill the boiler. On the Grand Trunk Railway it is found that 112 lb. of coal per hour in the stationary plant will maintain 150 lb. pressure in the boiler of a locomotive in the running shed, while 345 lb. of coal per hour would be required for a fire in the engine fire-box. Although this pressure is not usually carried on engines in the running shed, it is estimated that with the stationary plant there is a saving of 630 lb. to 800 lb. of coal for each engine in the shed.

Extra-high Pressure Step-down Transformer Station.

The first 220,000-volt step-down transformer station to be built in Canada is now being erected by the Ontario Hydro-electric Power Commission on a site in the town of Leaside, Ontario, just north-east of Toronto. This station, when completed, will also be one of the largest single stations on the Continent, and will have a number of new features which will be studied with interest by engineers and others having similar undertakings in contemplation.

Some time ago a contract was made with the Gatineau Power Company, a subsidiary of the International Paper Company, for the supply of 260,000 horse-power of 25-cycle current, to be delivered to the Commission at the international boundary—the Ottawa River—near Ottawa. In order to bring the energy from the place of delivery to a point where it could be fed into the Niagara system, two single-circuit transmission lines which will operate at 220,000 volts will be required. These lines will be the first in Canada at this voltage, and each will be approximately 230 miles in length. The first line is now under construction. The logical point for the western termination of the 220,000 volt lines was in the vicinity of Toronto, at its eastern boundary, and Leaside was selected.

The new station site covers twelve acres, that relatively large area being necessary because of:—(1) The quantity of power concentrated there; (2) outdoor construction; (3) provision for supplying the power to both the Toronto hydro system distribution circuits at 13,200 volts and also to the Niagara system at 110,000 volts; and (4) necessity for large size synchronous condensers.

The 220,000-volt lines terminate on a bush and may be disconnected from it by means of large oil-circuit breakers and disconnecting switches. Each oil circuit breaker is approximately 22ft. high to the top of the bushing, and occupies an area of 45ft. by 10ft. Each tank, of which there are three per circuit breaker, requires 5000 gallons of insulating oil. In spite of the large size of these breakers, and their heavy moving parts, it is expected that they will completely interrupt the circuit in one-half second. Seven of these circuits breakers will be required to handle the contract load.

The 220,000-volt circuit, after passing through circuit breakers and disconnecting switches, passes to the 220,000-volt terminals of the power transformers. The transformers are believed to be the biggest single-phase water-cooled units ever built. Four of these banks of transformers will be required to handle the Gatineau energy, the capacity of the station being 180,000 kVA, or just over 240,000 horse-power.

The 110,000-volt windings of the transformers provide a means of interconnection whereby the Gatineau power may be taken directly and absorbed into the 110,000-volt Niagara system. It also provides means whereby, in case of necessity, power could be brought in from the Niagara system through the 110,000-volt windings of the transformers to supply customers receiving power from the Leaside Station.

The control of all circuit breakers, disconnecting switches, tap changers and synchronous condensers is centred in a control room 23ft. by 45ft. There there are to be metering instruments which will enable the operators to know at all times the conditions of voltage, power factor and load, and thus be in a position to control the equipment to best advantage, and perform any necessary adjustments in the quickest possible time. The control of the large breakers is effected by manipulating little switches no larger than the switches used for ordinary house lights, a group of these small control devices being assembled on the top of a desk about the size of the usual office desk, thus concentrating, beforo the operator, means of opening or closing the main circuits. Signal lights on the desk show him at a glance the position of such apparatus.

Active work at Leaside was started about April 1st, this year, the first building to be constructed being the erection building required for the assembly of the electrical equipment. This building is fitted with a 75-ton electrically-operated overhead travelling crane to facilitate the handling of heavy parts. The progress schedule requires the first portion of the station to be ready to receive power by October 1st next.

As a safeguard against explosions on board its oil tankers, when they are loading or discharging, the Standard Oil Company is adopting a system of supplying the tanks with an inert atmosphere. It is provided by sucking flue gas from the boiler uptake and scrubbing the gas with water.

The Flexibility of Plain Pipes.

By J. R. FINNIECOME, M. Eng. (Zurich), M. Soc. Ing. C. (France).

No. II.*

(III.) Comparison of Theoretical Values with Actual Test Figures.

The two essential factors which are required to make a design absolutely successful are theoretical knowledge and practical experience. Each is the complement of the other. The more our theoretical values are compared with test values, the greater will be our confidence in the design. All successful designers must carry out tests after the completion of the design, or must possess the knowledge that the theory they apply has been confirmed by extensive tests, or, if necessary, that a test factor has been obtained and used.

The designer is in a position to calculate, for example, the theoretical deflection of a semi-circular plate or diaphragm, the theoretical vibration of a turbine disc, the theoretical torsional oscillations of a complete system of revolving elements, but his desire for truth compels him to make tests to discover how nearly the theoretical values and test figures agree. The ratio of the test figures to the theoretical values forms the basis of new designs. A number of troubles and disappointments in design have been removed by adopting this policy.

For this reason it is very essential to ask ourselves in what way the theoretical deflection-thrust factor, deflection-stress factor, and thrust-stress factor of pipe bends differ from those of actual tests. It is regrettable that no tests have been published in this country on the flexibility of pipes. Most manufacturers of pipes are not in a position to give the designer of pipe lines the information of this character which he desires, although their engineers are familiar with the fact that expansion due to temperature rise can be very troublesome—in fact, so troublesome that they may be forced to re-design the piping lay-out.

In this article the author will endeavour to give a complete survey of tests on expansion bends which have been published during the last seventeen years, and most of the information will be drawn from the work of foreign experimenters. The tests will be examined on the basis of the theoretical formulæ derived in the first article. The tests which will be considered were carried out in Germany and America by (1) Professor Bantlin, 1910; (2) Crane Company, 1915; (3) S. Crocker and S. S. Stanford, 1922; (4) Professor Hovgaard, 1926.

(1) *Professor Bantlin's Tests on Lyre-shaped Bends* (*Table V. and Fig.* 13).—These tests are probably the most interesting, as the test data are so complete that a very careful analysis can be made. Professor Bantlin determined not only the deflection in the direction of thrust at the two flanges, but also took vertical and horizontal deflection readings at a large number of points on the mean curvature of the lyre-shaped bend. By means of these readings he was able to obtain the relative deformation along the mean curvature.

Table V. gives a summary of the particulars of the lyre-shaped bends—Fig. 13—and also the test figures giving the thrust and the test and theoretical deflection. The theoretical deflection (Col. 21) has been calculated by the author's formula (12) derived in the first article. Professor Bantlin has also calculated the theoretical deflection (Col. 22) by a formula which involves considerably more mathematical work.

The test ratio, *i.e.*, the ratio of the test to the theoretical deflection, is given in Col. 24, with the latter calculated by formula (12), and in Col. 25 with the theoretical deflection calculated by Professor Bantlin's formula—published in "Zeitschrift des Vereines deutscher Ingenieure," 1901, p. 164—which expresses very accurately the elastic deformation of a curved bar. The author's formula (12) is based on the theory of simple bending of a straight beam by a couple, the shearing force being neglected. This formula can be applied with sufficient exactness to cases in which the mean radius of curvature is large in comparison with the cross-sectional dimensions of the beam. Comparing the theoretical deflections given in Col. 21 with those in Col. 22, we find that for bends Nos. 1, 2, 3 and 5 the formulæ agree very closely, and therefore that the simple bending theory can be applied with the same accuracy as Professor Bantlin's formula. But bend No. 4 gives a smaller deflection when calculated by the simple bending theory, the reason for this discrepancy being that the cross section of the pipe—125 mm. bore, 4·19 mm. thick—is small compared with the mean radius of curvature. This fact is distinctly shown by the much smaller moment of inertia with approximately the same mean radius of bend—bend No. 3: $R_1 = 831$ mm.; $I = 2371{\cdot}1$ cm.^{4}; and bend No. 4: $R_1 = 802{\cdot}5$ mm.; $I = 352{\cdot}07$ cm.^{4}.

The following five lyre-shaped bends were tested:—(*a*) Nos. 1 and 2: Two mild steel bends having the same rectangular cross section and mean inside radius R_1, but different mean outside radius R_2. (*b*) Nos. 3 and 4: Two mild steel pipe bends having different bores and different mean inside and outside radii. (*c*) No. 5: One cast iron pipe bend having the same outside diameter and mean inside radius R_1 as the mild steel pipe bend No. 3. No. 5 bend was specially made so as to compare the mild steel and cast iron pipe of the same outside diameter and same mean outside and inside radii.

In analysing these five lyre-shaped bends, we find that the calculated and the test deflections—Cols. 21 and 23—practically agree. The mild steel pipe, No. 3, however, gives a test deflection 4·9084 times greater than the calculated, and bend No. 4 a test deflection 3·29 times greater than the calculated.

The values in Cols. 24 and 25 give the ratios of the test and calculated deflection-thrust factors, using the author's and Professor Bantlin's formula respectively. The pipe designer is interested not only in this ratio, but also in the test ratio of the thrust-stress factor, as the latter determines the actual maximum bending stress in a pipe bend for a given thrust. To determine this ratio we must make a tensile test piece from the material taken from the pipe from which the bend has been made. From the load-strain diagram we obtain the yield point of the material. The yield point of the actual bend is determined by gradually increasing the load and measuring the deflection, which is then plotted as a function of the load. The deviation of the deflection from the proportionality to the load indicates that the bend has reached the stress at the yield point. For this thrust corresponding to the yield point, the theoretical stress is calculated and the ratio of the yield point obtained from the test piece to this calculated stress gives the test ratio of the thrust-stress factor. This has been done for bend No. 3. The test piece gave a yield point of 2900 kilos. per square centimetre, and the bend yielded with a thrust of 1380 kilos., which corresponds to a bending stress calculated by formulæ (5) of 1421·5 kilos. per square centimetre, so that the ratio

$$\frac{1421{\cdot}5}{2900} = 0{\cdot}4898$$

gives the test ratio of the thrust-stress factor. We thus find that for the same thrust under test conditions the stress is 2·041 times greater than the theoretical longitudinal bending stress, but that the deflection is 4·9084 times greater than the theoretical deflection, so that the test ratio of the deflection-stress factor is equal to 2·405. It therefore follows that for the same test deflection the stress is 0·4159 times the theoretical longitudinal bending stress.

As the three test ratios which determine the flexibility of a pipe are of special interest, they are summarised below for this particular mild steel bend of 200 mm. bore.

(*a*) Test ratio of the deflection-thrust factor—

$$\frac{C_H\ (\text{test})}{C_H\ (\text{theor.})} = 4{\cdot}9084.$$

(*b*) Test ratio of the thrust-stress factor—

$$\frac{C_T\ (\text{test})}{C_T\ (\text{theor.})} = \frac{1}{2{\cdot}041} = 0{\cdot}4898$$

(*c*) Test ratio of the deflection-stress factor—

$$\frac{C_S\ (\text{test})}{C_S\ (\text{theor.})} = 2{\cdot}405.$$

These figures show distinctly that when we are considering the flexibility of a pipe it is essential to know these three factors. At least the test ratios of two of the above factors are required for determining the actual deflection, stress and thrust of a pipe bend. The lyre-shaped bend No. 4 was not tested for the actual yield point, so that the author is not in a position to determine the test ratio of the thrust-stress factor and the deflection-stress factor.

Professor Bantlin is of the opinion that the great difference between the theoretical and the test deflection of mild steel bends is due to (1) the variable thickness of the pipe; (2) creases or waves formed on the inside curvature (compressive side) of the bend; (3) distortion or flattening of the circular cross-section which becomes elliptical; (4) thinning of the material caused by tension on the outside radius during the bending operation; (5) thickening of the material caused by compression on the inside radius, during the bending operation.

The situation of the creases or waves was carefully examined on the mild steel bends Nos. 3 and 4, and the following was the result:—Bend No. 3: (*a*) Twenty-eight creases, varying from 0·4 mm. to 1·6 mm. deep on the inside curvature of portion B C D—Fig. 13. (*b*) Six creases varying from 0·7 mm. to 1·9 mm. deep on the inside curvature of portion A B. (*c*) Eleven creases varying from 0·4 mm. to 2·1 mm. deep on the inside curvature of portion D E. Bend No. 4: (*a*) Twenty-five creases varying from 0·4 mm. to 2·0 mm. deep on inside curvature of portion B C D. (*b*) Ten creases varying from 0·5 mm. to 2·0 mm. deep on inside curvature of portion A B.

Table V.—*Tests on Lyre-shaped Expansion Bends by Prof. Bantlin* (1910).

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No.	Type.	Bore d.	O.S. diam. d_1.	I.S. diam. d.	Wall thickness δ.	R_1.	R_2.	$\frac{R_1}{R_2}$	l_1.	l_2.	l_3.	y_1.	y_{max}	γ.	β.	C_H (calc.)	I.	E.	H.	Δ_1 (calc.). Author form. (2)	Δ_1 (calc.). Bantlin.	Δ_1 (test)	$\frac{\Delta_1\ (\text{test})}{\Delta_1\ (\text{calc.})}$. Author.	$\frac{\Delta_1\ (\text{test})}{\Delta_1\ (\text{calc.})}$. Bantlin.
		mm.	mm.	mm.	mm.	mm.	mm.		mm.	mm.	mm.	mm.	mm.				cm^4.	kg./cm^2.	kg.	mm.	mm.	mm.		
1	M.S. rectangul'r bar	—	80 × 79·4		—	500	300	0·6	1093·5	45·0	45·0	884·0	1384	136° 53′	43° 7′	22·507	338·77	2·1 × 10^6	300	11·86	11·88	12·3	1·037	1·035
2		—	79·7 × 80·3		—	501	450	0·8982	1399·3	45·0	45·0	1094·1	1595	132° 38′	47° 22′	32·884	343·89	2·1 × 10^6	300	17·17	17·19	16·9	·9838	·983
3	M.S. pipe	200	215·2	201·9	6·65	831	558·3	0·6718	2150	125	125	1438·9	2269·9	129° 19′	50° 41′	21·615	2371·1	2·103 × 10^6	900	22·39	22·53	109·9	4·9084	4·878
4		125	133	124·6	4·19	802·5	435·0	0·5420	1740	302·5	302·5	1315·1	2117·6	135° 20′	44° 40′	15·671	352·07	2·103 × 10^6	200	21·88	27·65	72·00	3·290	2·603
5	C.I. pipe	—	215·5	178·4	18·55	830	560	0·6747	1914·5	247·7	247·7	1568·1	2398·1	136° 29′	40° 31′	25·286	5614·7	0·9 × 10^6	600	17·16	17·26	16·90	·985	·970

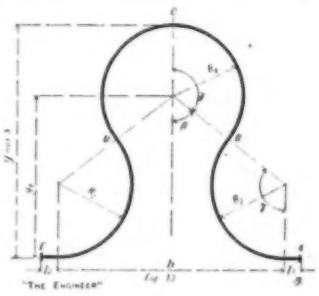


Fig. 13

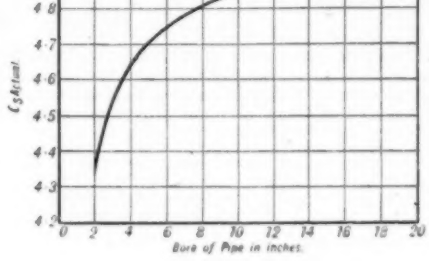


Fig. 14 Actual Deflection-Stress Factor for U Bends obtained from Actual Safe Expansion Values. Recommended by the Crane Co. (U.S.A.)
C_S Actual
Bore of Pipe in inches.

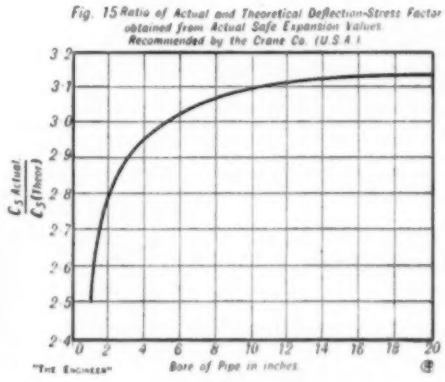


Fig. 15 Ratio of Actual and Theoretical Deflection-Stress Factor obtained from Actual Safe Expansion Values. Recommended by the Crane Co. (U.S.A.)
$\frac{C_S\ \text{Actual}}{C_S\ \text{(Theor.)}}$
"The Engineer"
Bore of Pipe in inches.

Figs. 14 and 15

* No. I. appeared August 17th.

(c) Thirteen creases varying from 0·5 mm. to 1·5 mm. deep on inside curvature of portion D E.

(2) Tests by the Crane Company, U.S.A.

The Crane Company manufactures pipes of any size and shape, and is the only firm which has made exhaustive tests on pipe expansion bends. Its published results are of the greatest value to pipe designers. In 1915 the firm's mechanical experts department carried out over fifty extensive tests with various types of mild steel bends from 4in. bore upwards. The pipes were anchored at one end and carried on roller supports, so that the strains due to expansion or contraction were properly directed to the bend. The bends were then extended and compressed repeatedly until something failed. The experimenters were in this way able to determine the maximum permissible safe expansion. This information was published in the *Valve World*, and included a series of curves for U-bends and a table for 90 deg. bends, which gave the permissible safe expansions for a stress of 15,000 lb. per square inch.

The author has analysed 120 points on the series of curves for U bends. A summary of the actual deflection-stress factors for U bends obtained from actual safe expansions recommended by the Crane Company is given in Table VI. It will be seen that

Table VI.—*Actual Deflection-Stress Factors for U Bends, Obtained from Actual Safe Expansion Values Recommended by the Crane Company, U.S.A.*

1	2	3	4	5	6
Bore of pipe, in.	Mean radius of bend, in.	C_H (actual). Min.	C_H (actual). Max.	C_H (actual). Average.	C_H (actual) / C_H (theor.) C_H (theor.) = 1·57.
1	12 to 40	3·89	4·0	3·9	2·484
2	15 to 70	4·32	4·45	4·36	2·777
3	15 to 90	4·44	4·50	4·48	2·855
4	20 to 100	4·62	4·67	4·65	2·962
5	30 to 120	4·68	4·75	4·72	3·000
6	30 to 120	4·67	4·83	4·75	3·025
8	40 to 120	4·75	4·93	4·80	3·056
10	50 to 120	4·83	4·90	4·86	3·096
12	60 to 120	4·67	4·95	4·87	3·108
14	70 to 120	4·75	5·0	4·89	3·115
16	80 to 120	4·80	4·98	4·89	3·115
18	Above 120	4·82	5·00	4·90	3·125
20	Above 120	4·87	5·00	4·93	3·140

with varying mean radii of the bend, the deflection-stress factor varies very little over a large range for the same bore. The minimum and maximum for each bore are given in Cols. 3 and 4 respectively. The average actual deflection-stress factor for a number of pipes of the same bore, but different mean radii, is given in Col. 5, from which it will be seen that the actual deflection-stress factor varies from 3·9 for 1in. bore to 4·93 for 20in. bore. This increase takes place rapidly up to a pipe of 10in. bore and then slowly up to a pipe of 20in. bore. The deflection-stress factor is plotted as a function of the bore in Fig. 14.

Of great importance to pipe designers is the test ratio, *i.e.*, the ratio of the actual deflection-stress factor to the theoretical deflection-stress factor. This ratio is given in Col. 6, Table VI., and is plotted as a function of the bore in Fig. 15. This test ratio varies from 2·484 for 1in. bore to 3·14 for a 20in. bore.

(3) Tests by S. Crocker and S. S. Sanford (Detroit Edison Company).

In 1922 the Detroit Edison Company, after several minor mishaps to its steam pipes, investigated whether they could be avoided by improved design. At that time the company was undertaking the design of its Maryaville power station. The company decided to investigate the flexibility of mild steel pipes by carrying out tests on expansion U bends and lyre-shaped bends. Particulars of the eight tests conducted on expansion bends with the theoretical and test deflection-thrust factor are summarised in Table VII. The two types of expansion bends are represented in Figs. 16 and 17. The ratio of the test and theoretical deflection thrust factors is given in Col. 12, Table VII. For U bends it will be seen that for a 6in. bore it varies from 1·0 to 1·791, giving an average of 1·39. For the 10in. pipe, with $R/d = 6$, the ratio is equal to 2·207. For the lyre-shaped bends of 4in. and 6in. bore, we get a ratio varying from 1·0 to 1·02.

Table VII.

Tests on Expansion U Bends and Lyre-shaped Bends.

S. Crocker and S. S. Sanford (Detroit Edison Co.), 1922.

Fig. 16

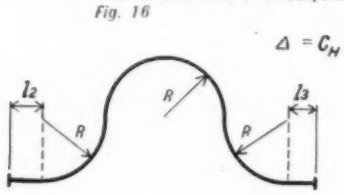
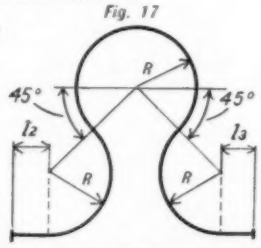


Fig. 17



1	2	3	4	5	6	7	8	9	10	11	12
Test No.	Type.	Fig.	Bore d.	Mean radius R.	$\lambda = \frac{R}{d}$	Wall thickness δ	l_2.	l_3.	C_H (theor.).	C_H^1 (actual).	Test ratio C_H^1 (test) / C_H (theor.).
			In.	In.		In.	In.	In.			
1	Expansion U bend	16	6	30	5	0·270	9	9	9·4248	14·08	1·493
2			6	30	5	0·274	50·75	12	9·4248	16·88	1·791
3			6	30	5	0·285	9	14·625	9·4248	12·02	1·275
4			6	36	6	0·418	7	7	9·4248	9·42	1·000
5			10	60	6	0·336	10	10	9·4248	20·8	2·207
6			3½	27	8·31	0·12	7	7	9·4248	9·42	1·000
7	Lyre-shaped bend	17	4	28	7·0	0·237	5	5	39·888	40·70	1·020
8			6	36	6	0·410	7	7	39·888	39·9	1·000

(b) *Walworth Lyre Bend* —These tests were carried out on a 6in. lyre-shaped bend presented by the Walworth Manufacturing Company. The variation in the diameter was very small, and the radius of bend was uniform. The average thickness of the pipe was determined by weighing the pipe and was found to be 0·2645in. The average mean radius of the bend was equal to 4·885 times the bore of the pipe. The principal dimensions are given in Table VIII. The bend was set up in a testing machine and an initial load of 300 lb. was applied, which was taken as the basis for measuring the load, deflection and thrust. The load was increased by increments of 700 lb., 1200 lb., and 1700 lb., and after each step reduced to 300 lb. At an increment of 1200 lb., corresponding to a total load of 1500 lb., no permanent set was observed after releasing the load to the initial load of 300 lb. At the highest total load of 2000 lb., after releasing the load to 300 lb., a permanent set of 1·12in. was recorded, indicating that the yield point had been exceeded.

The theoretical deflection of this lyre bend was calculated by formula (12) for the thrust of 1200 lb. and was found to be 1·339in. The actual test deflection was 2·94in., so that the ratio of the test and theoretical deflections was equal to 2·196.

(To be continued.)

Table VIII.

Tests on Expansion U-Bend and Lyre-shaped Expansion Bend by Professor W. Hovgaard (1926). Experiments made at the Massachusetts Institute of Technology.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
No.	Manufacturer.	Type.	Fig.	Cross section. I.S. diam. d	Cross section. Mean diam. 2r	Cross section. O.S. diam. d_1	Wall thickness δ	R_1.	R_2.	R_2/R_1	l_1.	l_2.	l_3.	L_1.	y_1.	y_{max}	γ.	β.	C_H (theor.)	I.	E.	H.	Δ_1 (calc.) author formula (12).	Δ_1 (test) Hovgaard	$\frac{\Delta_1 \text{ (test)}}{\Delta_1 \text{ (calc)}}$
				In.	In.	In.	In.	In.	In.		In.	In.	In.	In.	In.		Deg.	Deg.		In.⁴	lb./in.²	lb.	In.	In.	
1	Boston Navy Yard	Expansion U-bend	16	4·490	4·607	4·724	0·1175	12·8	—	—	55·17	43·44	43·77	142·38	—	25·60	—	—	9·4248	4·496	29×10^6	700	0·1061	0·570	5·38
2	Walworth Mfg. Co. (Boston)	Lyre-shaped bend	13	6·127	6·392	6·656	0·2645	30·31	29·57	·9751	97·72	7·625	7·625	112·97	64·43	94·74	125·4	54·6	31·386	27·120	29×10^6	1200	1·339	2·94	2·196

SIXTY YEARS AGO.

In 1866, Abdul Aziz Khan, the Sultan of Turkey, presented to this country one of the great bronze cannon from the Castle of Asia at the mouth of the Dardanelles. In return, Queen Victoria presented him with a rifled wrought iron gun made at Woolwich, complete with ammunition and adjuncts. Abdul's present was brought to this country by H.M.S. "Terrible," and was duly deposited at the Rotunda Military Museum on Woolwich Common. In our issue of August 21st, 1868, we described and illustrated the cannon. It weighed nearly 18½ tons, and was formed in two parts, a chase portion with a bore of 25in. and a length of 123½in., and a breech portion 81½in. long containing a powder chamber 9½in. in diameter and 75½in. in length. The two parts were united by means of a screwed spigot and socket. The threads were cast and had a pitch of 3½in. Each end of the two parts was provided with a flange 41½in. in diameter or, more precisely, with two flanges united at short intervals by rundles, between which the end of a hand spike could be inserted to tighten the two parts together, or to unscrew them and roll them over the ground. Granite balls, 24½in. in diameter and weighing each about 670 lb., accompanied the cannon. An inscription on the gun was interpreted as meaning that its proper charge of powder was 49½ lb., and that it should be fired at an elevation of 3 deg. The cannon was cast in A.D. 1464, eleven years after the Turks took Constantinople. It was believed to be the identical weapon which destroyed the British frigate "Active" when Admiral Duckworth forced the Straits in 1807. It was not clear who was the founder. An inscription on it described it as the work of Miné Ali, but we suggested that that was the name of the Turkish ordnance officer in charge of its production, and that the real founder was a Frankish artisan, Urban, or one of his pupils, who, about thirteen years before it was made, was employed by Mohammed II. to produce the similar huge guns which he required for battering down the walls of Constantinople. The gun could not be trained, but was fired when its target came into line with it. Recently, however, we recorded, some Prussian artillery officers had made a huge timber carriage for the Turkish Government, on which one of these great "kamerlichs" had been mounted, and on which it could be trained round a considerable angle. Our visit of inspection to the old gun inspired us with thoughts of what it had seen and what Europe had passed through since it was made. A lively picture of Mohammed II. formed the principal point in our look backwards. With a knowledge of what the Dardanelles and the forts on its shores have meant to the present generation, we are almost startled to find that our author of sixty years ago foresaw the events which took place in 1915. In a passage not wholly devoid of poetry, he wrote of the Dardanelles as "that narrow sea upon whose shores empires have arisen and have decayed, and fallen, and which have witnessed so many of the great struggles of the world for monarchy and dominion from the days of Persia and Macedon down to our own; and which are destined most probably to be the theatre yet of one of the decisive contests of the future."

Institute of British Foundrymen: John Wilkinson Medal.—The results of the "John Wilkinson Medal" examination held in connection with the Junior Section of the Lancashire Branch of the Institute of British Foundrymen, which was held in May last, are announced as follows:—First place and medal, J. E. Garside, Metropolitan-Vickers Electrical Company, Ltd.; second prize, H. Morris, National Gas Engine Company, Ltd., Manchester; highly commended, A. Burgess, Henry Hollindrake and Co., Ltd., Stockport; H. Morris, Whitehead and Poole, Ltd., Radcliffe; J. Pattison, Metropolitan-Vickers Company, Ltd.; and F. Topham, Hick, Hargreaves and Co., Ltd., Bolton.

• "The Elastic Deformation of Pipe Bends." Massachusetts Institute of Technology.

Railway Matters.

THE date fixed for the final stage in the Southern Railway Company's electrification scheme is March 3rd next. We have reason to believe that the progress of the work has been such that an earlier date may be possible.

RAILWAY accidents are very rare in the Isle of Man, and so, when they do occur, there is considerable alarm. Such was the case three years ago, when, on August 22nd, there was a buffer stop collision at Douglas, on the Isle of Man Railway. Now, there has been a more serious accident, but, fortunately, again without fatal results. This time it was on the Manx Electric Railway and occurred on August 8th. A train from Douglas to Laxey had occasion to stop in the section, and whilst at a stand was run into by a following train.

THE fatal derailment at Shepreth on August 17th which, as related in our Seven-day Journal, was caused by an express passenger train running into a motor lorry at an occupation crossing, prompts us to repeat what has often been mentioned in this column, namely, that the users of such crossings do so at their own responsibility. What the Railway Clauses Act, 1845, calls "accommodation crossings" are provided "for the purpose of making good any interruption caused by the railway to the use of the land through which the railway shall be made." Occupation crossings differ from public road crossings, as, under three different Acts of Parliament, the latter have to be protected by gates that fence off the railway from road traffic when the gates are open for public traffic, as well as fencing the road from the railway when closed against road traffic; they have to be worked by a gatekeeper and, under the Ministry of Transport Requirements for New Railways, have to be protected by, and interlocked with, signals. On the other hand, to quote Colonel Sir John Pringle's annual accident report for 1926, "In occupation and footpath level crossings no responsibility is placed upon railway companies by legislation for safeguarding movements of road vehicles or pedestrians.

WE regret to have to announce the death, on Saturday last, whilst on a holiday, of Mr. George Davidson, the divisional general manager for the North-Eastern area of the London and North-Eastern Railway. Mr. Davidson was born at Aberdeen and was intended for the legal profession. In 1886 he entered the service of Messrs. Adam, Thomson and Ross, of Aberdeen, who happened to be the solicitors to the Great North of Scotland Railway. When, in 1894, that company set up its own legal establishment, Mr. Davidson went with Mr. Ross to be chief assistant to that gentleman, who had been appointed the company's solicitor. The general manager of the railway at that time was Mr. William Moffatt, who carried out very extensive, though somewhat costly, improvements—the works at Inverurie. Mr. Davidson, in addition to his legal work, assisted Mr. Moffatt in this work and when, in 1904, the office of solicitor became vacant he was promoted to that position, and further, in 1906, was made the general manager also. Under the Railways Act, 1921, the Great North was to be part of the London and North-Eastern and so, until matters were adjusted, Mr. Davidson went to Edinburgh as solicitor for Scotland under the grouped company, and eventually to York to fill the office he occupied for nearly five years.

THE report for 1926–27 of the Indian Railway Board, under the heading "Supply of Rails and Fish-plates from Indigenous Sources," said that the seven-year contract with the Tata Iron and Steel Company for the supply of rails and fish-plates to the State-worked railways expired during the year. During that twelve months under review that firm supplied 97,163 tons to State-worked railways and 50,675 tons to company-worked lines. The Tariff Board imposes a duty of 13 rupees per ton and the maximum rail output of the Steel Company was estimated at 200,000 tons a year. If that duty was to be retained it was essential that the railways should purchase the whole of their requirements of rails in India as far as they could be produced in that country. The future price was affected by the reconstitution of the European Rail Makers' Association in the middle of 1926, under which each country reserves its own internal markets, which, in the case of the United Kingdom, included also the markets of the Dominions, India and the Colonies. No more continental rails would therefore be exported to India; and, further, it seemed improbable that the price of rails would be reduced. On the contrary, some increase might be expected, and in the Board's estimates an increase of 10s. per ton had been allowed for. Consequently, after discussion with the company-worked railways, a contract for another seven years had been entered into with the Tata Company.

THE derailment mentioned in the article "Depth of Locomotive Tire Flanges," on page 141 of THE ENGINEER of August 10th, occurred on January 13th last near Bridgnorth, on the Severn Valley branch of the Great Western Railway, and was, as said in that article, simple as to the cause. There was, it is true, again the question of the employment of tank engines, but that that was almost a side issue may be seen in the following remarks of Colonel Mount:—"Apart, however, from the loading of the engine and the effect it would be likely to have on the track, I am clearly of the opinion that the condition of the sleepers themselves made it unlikely that the road could be relied upon to carry, with a reasonable margin of safety, even the lighter tender types of engine at the speed at which it had apparently been customary to operate. The fact is that this section of the line was not being maintained to the standard requisite for the class of traffic expected, the reason being that there was evidently misjudgment or lack of appreciation in respect of the condition of these old sleepers, as affecting the security of the chair fastenings." It should be explained that this branch, under the system adopted by the company, was a "fellow" engine route, i.e., where the maximum axle load was 16 tons. Tender engines were the rule until recently, and they had a maximum axle load of 14 tons 15 cwt. The tank engine in question was of the A. 5 class, 2–6–2 type, with a maximum axle load of 15 tons 11 cwt. The weight, though, per foot run over the rigid wheel base was as much as 4·02 tons, as compared with 3·39 tons for the 4–4–0 type tender engine and 2·37 tons for the 0–6–0 tender engine.

Notes and Memoranda.

ACCORDING to Mr. Andrew Vogel, of the American Society of Civil Engineers, tests made with lap-welded steel bars showed that welding with a minimum contact distance of $\frac{1}{4}$in. and a maximum contact distance of $\frac{3}{4}$in. of fillet permitted a unit stress of 3000 lb. per linear inch.

IN a paper on "Four-high Mills," read before the Engineers' Society of Western Pennsylvania, Mr. F. C. Biggert, jun., explains that in a cold mill and at the finishing end of a hot mill, where the power requirement is greatest, the saving, due to the roller bearings, is about 50 per cent.; that is, equal tonnages of like sizes, rolled from like slabs, require about one-half the power in a four-high mill with roller bearings as would be required in a two-high mill with ordinary bearings. At the roughing end of a hot mill, where the metal is thick, this ratio probably does not apply, but the saving in power is substantial there also.

THE mechanisation of China is proceeding by such slow degrees as to be almost imperceptible. Yet in the important field of irrigation, writes a *North China Daily News* correspondent from Wusih, machines are, in this neighbourhood at least, doing a large part of the work formerly done by the treadmill. A dozen or more machine shops here now turn out an internal combustion engine which drives an efficient pump. These machines, mounted on boats, pass from place to place and contract for irrigating the rice fields, at so much a *mow*. The business is evidently good, as one sees these power boats on every canal and not one which will run is idle.

IT is reported that the British Broadcasting Corporation has been carrying out tests for some time with the object of determining whether it will be practicable to inaugurate an experimental service of picture transmission in the autumn—on no account to be confused with television. Several systems have proved successful; the "Fultograph," the invention of Captain Otho Fulton, is used by the Vienna broadcasting station, the only broadcasting station in the world which transmits pictures as well as speech and music. A station cannot simultaneously transmit ordinary broadcast matter and pictures unless it uses two wave-lengths. All receivers must be of the same make as the transmitter, to ensure synchronisation.

THE failure of one of the return tubes at the top of a water-tube boiler on a small steamer is attributed officially to wastage of the metal beneath a coating of scale, which was accentuated by the use of lime in the feed-water and a cement wash after cleaning. In his observations the Engineer-Surveyor-in-Chief, Board of Trade, says:—The smooth surface of the dark scale described would make it difficult to detect visually; but a hammer test on the outside of the tubes should have given indications by sound that the tubes were coated with thick scale inside. The corrosion had been taking place underneath this scale, and the use of a patented boiler fluid may have been the original cause; but if the tubes had been periodically cleaned the corrosion would have been more readily discovered.

AN article in *Industrial and Engineering Chemistry* describes an unusual achievement in electro-galvanising. A steel dryer drum, 8ft. 6in. diameter by 10ft. 6in. long, was to be electrolytically galvanised, the zinc coating to be one-sixty-fourth of an inch thick. To effect this, the drum was mounted in bearings fitted to a shallow wood tank in such a way as to allow about one-fifth of its surface to be submerged therein. The drum was then rotated at a speed slow enough to allow the galvanising solution to deposit, and yet fast enough to prevent oxidation or drying of the surface exposed to the air. The surface was brushed with steel brushes every fifteen minutes for the first twenty-four hours and every half-hour thereafter. The operation lasted 100 hours continuously. At the end of that period the solution was pumped out of the tank while the drum was kept rotating and was immediately washed with water and steam, then quickly wiped and dried, and finally the finished surface was wire-brushed. Careful examination revealed a satisfactory result.

ACCORDING to Mr. Allison J. Thompson, vibration presents a real problem in industrial lighting. Two types of vibration are particularly destructive to the lamp filament. The first, and apparently the most common, has a short wave-length with a high intensity, producing a sharp jolt which breaks the filament. The second type of vibration has a very short wave-length of high and rhythmic frequency, producing a molecular disturbance in the filament, which in time will cause it to break. When the vibrating structure adjacent to the lamp is more or less compact and rigid, as in the case of various kinds of machinery, this second type of vibration may develop a very short wave-length of high and rhythmic frequency, exceedingly destructive to the filament. The farther the lamp can be removed from the source of vibration, and the greater the resilience of the supporting medium, the longer will be the wave-lengths and the less destructive will be the effect of the vibration upon the filament. Many devices, known as "shock absorbers," have been developed to provide the desired protection.

AN interesting demonstration in connection with an overhead transmission line now being erected for the Shropshire Electric Power Company took place last week. The power line when completed is for the purpose of conveying current from the Stourport electric power-house of the Shropshire Company to Bridgnorth and district. The poles for carrying the power line are of the steel lattice type, and up to quite recently the usual practice has been to erect the poles in sections. The demonstration given was raising one of the poles completely equipped from a horizontal position on the ground, and this was accomplished in one and a-half minutes from start to finish; that is, the pole was hoisted and bolted down. The method adopted needed only the use of shear legs and a new six-wheeled motor vehicle. The steel lattice pole was close on 60ft. in height and weighed approximately 3 tons. The party attending the demonstration, which took place in the neighbourhood of the village of Alveley, which lies between Kidderminster and Bridgnorth, were taken from the village to the site of erection in two of the above-mentioned vehicles.

Miscellanea.

AN office building of seventeen storeys is to be built in Manchester.

THE tenth Model Engineers' Exhibition opens on September 15th in the Royal Horticultural Hall, Westminster.

A MACHINE for removing the bones from kippers, at the rate of 2500 fishes per hour, has been set to work at Fleetwood.

THE smelting plant which is being put up at Sudbury, Ontario, by the International Nickel Company, is to have a capacity of 3000 tons a day.

AN aerodrome will probably be constructed by the Government of India about 15 miles from Talghat, on the Madras-Salem-Cochin Railway.

EXPERIMENTS are being carried out in Canada on the eradication of bud worm in spruce forests by means of dusting with calcium arsenate from aeroplanes.

THE coal mines of Coalisland, Co. Tyrone, have been closed down on account of trouble with water and the steep dip of the seams. The fire-clay mine is, however, still working.

A GALVANISING kettle, 27ft. long by 4ft. by 4ft., capable of holding 130 tons of molten zinc, has recently been put to work by the Staten Island Shipbuilding Company, New York.

A CONTRACT for the construction of coke ovens and by-product plant, at a cost of about £1,000,000, has been placed with the Coppée Company (Great Britain) by the Broken Hill Proprietary Company, of Newcastle, New South Wales.

WORK will be begun at an early date on the construction of the submerged dams in the St. Lawrence River between Montreal and Sorel, which are intended to improve navigation in times of low water.

INFORMATION has just reached Geneva to the effect that the line of oil pipes to be laid from Mosul is to be carried to Haifa, in the British mandated territory of Palestine, and not to any other port. It is also declared that the Royal Dutch Petroleum Company will erect big refinery works close to Haifa Harbour, and for this purpose it is reported the company has already purchased land.

WHAT is claimed to be the world's largest steel tank is, according to the *Ironmonger*, being made by Braithwaite and Co., Ltd., at Newport, Monmouthshire, to the order of the Government of Sarawak, Borneo, for the storage of the water supply of Kuching, the capital. The tank, which will be 160ft. long, 160ft. wide, and 16ft. high, will hold 2,500,000 gallons of water. It will be composed of 4ft. square pressed steel plates.

UNUSUAL interest attaches to the report, officially confirmed, that economies amounting to over £375,000 have been effected during the past financial year by the Electricity Department of Glasgow Corporation. It is also stated that the debt of the department has been reduced by £145,000, and the hope is expressed that during the current year a further decrease of about £300,000 in the outstanding debt may be effected.

THE extent to which photography can be employed to solve various commercial problems will be demonstrated at the exhibition of the Professional Photographers' Association, to be held at Princes' Galleries, Piccadilly, London, W. 1, in September. There will be a special commercial section illustrating the adaptation of photography to every branch of industry—from selection and grading of raw material to the marketing of the finished product.

THE clearing of the route for the transmission line which will convey current from the Bridge River power plant to Vancouver has been started, and over 20 miles will be completed before operations on this portion of the work are concluded this year. The transmission line will follow the route of the Pacific Great Eastern Railway to Squamish and will then continue its way into Vancouver through the Capilano or Seymour valleys. Electrical energy will be transmitted at 165,000 volts.

CONSEQUENT upon the criticisms directed against the lighting of the approaches to the Thames, the Board of Trade has, in conjunction with Trinity House, agreed upon a scheme which will cost about £4900. A light of 200,000 candle-power will be exhibited, and in addition there will be a fog signal and submarine bell. The light will thus be a much more powerful one than is at present installed. The position of the Kentish Knock vessel will remain unaltered, but there, too, a more powerful red light will be shown, much greater in intensity than the present white light. It will be entirely distinct from any other light in the vicinity. The Diaphone fog signal will be supplemented by a marine oscillator. The red glass necessary for the Kentish Knock Station will be supplied by Chance Bros. and Co., Ltd.

ACCORDING to a report by the engineer-in-charge of the new Welland Ship Canal, just issued by the Canadian Department of Railways and Canals, the waterway is expected to be ready for traffic by 1930. Up to March 31st last, over £18,800,000 has been expended on the project, the completion of which involves a total outlay of some £24,000,000. The canal, which is over 25 miles long, is virtually in a straight line, and has locks capable of taking vessels with a draught of 30ft. The 25ft. canal can be readily deepened to the 30ft. depth. Lock No. 8, the last on the Lake Erie end of the undertaking, is the longest in the world, being 1380ft. long between inner gates, and rivalled in length only by two locks on the American side at the Sault Ste. Marie Canal, both of which are 1350ft. long. The construction of this lock, which has been under way since the summer of 1926, is now virtually completed. A notable engineering feat in connection with Canada's major canal has been the construction of the 2000ft. breakwater at Port Colborne, extending into Lake Erie from the end of the canal, which was formed by sinking reinforced concrete cribs on a prepared bottom, and covering them with a heavy concrete superstructure. It is further protected by a heavy rock embankment dumped on the south-east side.

COKE OVEN PLANT AT PARKGATE, ROTHERHAM

(For description see page 191)

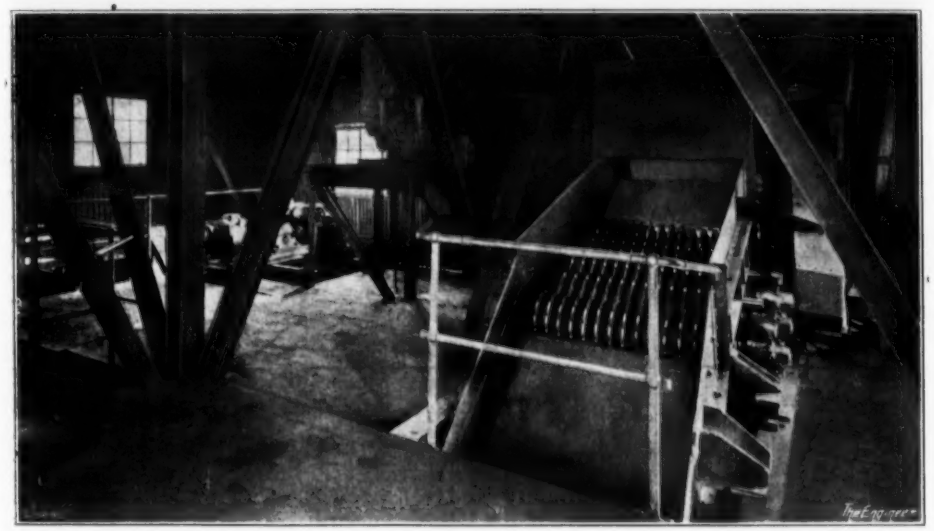


FIG. 23—ROTARY GRIZZLY

FIG. 24—BREEZE CONVEYOR

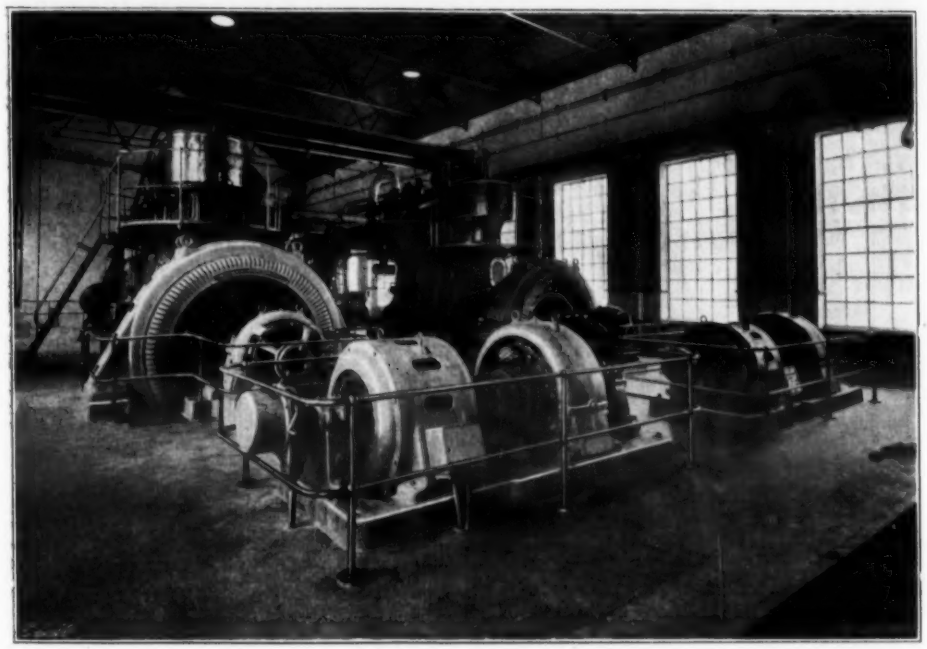


FIG. 25—POWER HOUSE

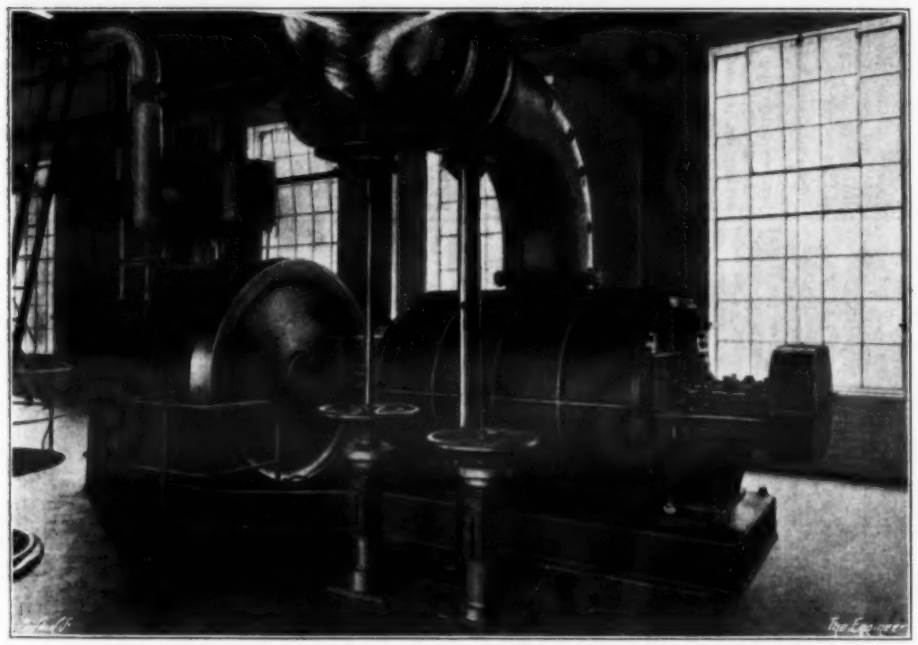


FIG. 26—GAS EXHAUSTER

The Engineer

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THE ENGINEER.

AUGUST 24, 1928.

The New Australian Squadron.

H.M.A.S. "AUSTRALIA," the flagship of Rear-Admiral Hyde, commanding the Australian Squadron, sailed from Portsmouth on August 3rd for Sydney. She is to call *en route* at Montreal, Quebec, and Halifax, and also at Boston and New York. To our Canadian kinsmen this visit will afford visual evidence of Australia's practical interest in Imperial defence, an interest which, from the close of the war until a very recent date, had not been too pronounced in the case of Canada herself. To our friends in the United States the visit of this fine cruiser will come as a reminder of the solidarity of the British Empire. From New York the "Australia" proceeds by way of Chesapeake Bay and Jamaica to the Panama Canal, thence to Tahiti and Wellington, New Zealand. Appropriately enough, she will enter Brisbane harbour on Trafalgar Day, October 21st, terminating her long voyage at Sydney two days later. The second cruiser, "Canberra," is to sail for Australia in a few week's time, after receiving the finishing touches on the Clyde, where both she and her consort were built. She is to proceed by way of the Cape of Good Hope. From the point of view of Imperial politics, the completion of these two ships is an event of no small significance. Together with the submarines "Oxley" and "Otway" and the seaplane carrier "Albatross," their construction was authorised in the Commonwealth naval programme of 1924, which was—to use an Americanism—Australia's "reaction" to the British Labour Government's decision to stop work on the Singapore naval base. The five vessels represent a capital outlay of £7,500,000. When the cost of their maintenance is taken into account, it will be agreed that Australia is making a handsome contribution to the naval resources of the Empire.

Upon the introduction of the programme, both the industrial and labour interests in Australia demanded that all the ships should be built in that country. This demand was resisted by Mr. Bruce, the Prime Minister, on the grounds of economy, as the cost of construction in Australia would have been very much higher than in Great Britain. Eventually, the two cruisers were ordered from John Brown and Co., Ltd., Clydebank, and the two submarines from Vickers Ltd., of Barrow; while the State Dockyard at Cockatoo Island, Sydney, was entrusted with the construction of the seaplane carrier. As the cruisers have cost about £2,000,000 each and the submarines about £400,000 each, these Australian contracts have benefited British industry to the extent of nearly five million pounds. The "Australia" and "Canberra" are replicas of the "Kent" class, though some slight modifications may have been made in the design to suit the requirements of Australian service. Both were launched last year, the former on March 17th, the latter on May 31st. The length overall is 630ft., the breadth 68ft. 4in., the mean draught 16ft. 3in., and the standard displacement 10,000 tons. Provision is made for the stowage of 3400 tons of fuel oil, sufficient for a voyage of 10,400 miles at economical speed. They are armed with eight 8in. guns of the newest model, paired in turrets, four 4in. A.A. guns, twenty lighter pieces, and eight 21in. torpedo tubes on quadruple carriages. Leaving aside the general question as to the utility of a torpedo armament in large ships, the height at which these tubes are mounted above the waterline is not conducive to the accurate running of the torpedoes. Probably the fighting value of the ships would be improved if two or more A.A. guns were substituted for the tubes. With this minor exception, however, the two cruisers are extremely well designed and should prove thoroughly efficient for their duties. Like the "Kent" and her sisters, they are fitted with geared turbines and Yarrow oil-burning boilers, developing 80,000 S.H.P., the designed maximum speed being 31·5 knots. Although this is somewhat less than the paper speed of certain cruisers being built abroad, it will doubtless be found that the British ships are but little, if at all, inferior when the respective performances under full load are compared. Judging from the evidence of the camera, the phenomenal trial speeds of the foreign cruisers we have in mind were attained when the vessels lacked part of their heavy armament and other equipment. Speed "records" established under such artificial conditions are of no great practical value. On a recent visit to Portsmouth Dockyard we were able to make a thorough inspection of the "Australia." In this class of vessel the Admiralty designers have had to work within the rigid limits of tonnage imposed by the Washington Treaty, and their task has not been rendered easier by the demands of the naval men for an exceptionally powerful armament, coupled with at least a moderate degree of protection, high speed, and an extensive cruising radius. Under no circumstances must the net weight of the ship, complete with all equipment and stores, save fuel and reserve feed water, exceed 10,000 tons. To satisfy these conflicting requirements it was probably found necessary to accept a rather lighter scantling than had been customary in British warship practice, though, thanks to recent metallurgical developments, that has not necessarily involved any sacrifice of strength. In the course of our tour through the ship, we observed many weight-saving devices, notably the widespread use of aluminium for internal fittings. Perhaps the most striking feature of the design is the amplitude of space above and below deck, in conjunction with a highly efficient system of ventilation. Owing to the exceptional height of the freeboard, it has been possible to provide roomy quarters for officers and men, in which respect these ships offer a most favourable contrast to our older and smaller cruisers of the "D" and "C" classes. Furthermore, the "County" ships have proved themselves to be excellent seaboats, steady and dry in a seaway, which is more than can be said of the older craft. Although it is a healthy tradition for British naval officers and ratings to speak well of the ships in which they serve—even when a less-prejudiced witness might give very different evidence—the testimony of officers in the "Australia" with regard to her behaviour at sea leaves no room for doubt as to her fine nautical qualities. We heard an equally favourable judgment on her armament. The 8in. guns carried by this class are much more formidable as to range, armour penetration, and explosive effect than their calibre indicates. We believe it to be a fact that the gunnery trials of all the "County" criusers have given complete satisfaction. The only weak point of this class is their inadequate protection. It is true that the hulls are bulged and well subdivided to minimise the effects of underwater attack, but as regards defence against gunfire they leave much to be desired. That is inevitable, in view of the restricted dis-

placement and the disproportionate weight allotted to machinery and armament; but the fact remains that a duel between cruisers of the new type, each practically destitute of armour and mounting guns of great destructive power, promises to be a most deadly affair. One or two well-placed salvos would probably decide the issue.

The Australian submarines "Oxley" and "Otway" were launched at Barrow two years ago. Generally speaking, they conform to the design of the British "O" class. According to the official "Return of Fleets," they displace 1400 tons on the surface and 1835 tons when submerged. The designed horse-power of the internal combustion motors for surface propulsion is 3000, giving a speed of 15·5 knots. Both vessels left Portsmouth for Australia, without escort, on February 8th last. On the voyage to Gibraltar they encountered weather of exceptional severity, and upon arrival at Malta it was announced that both had developed machinery defects which would have to be repaired before they could proceed. On March 19th Mr. Bruce, the Prime Minister, issued a statement to the effect that "experiments had been made in the design and construction of the submarines, which were of the most modern type," adding that "departures from accepted naval practice had been recommended by the British naval authorities and had been referred by the Cabinet to the Australian naval advisers for their concurrence." In a communiqué of the same date, Vickers-Armstrongs, Ltd., the builders, stated that "there had been some constructional weakness in the engine columns of these boats, in consequence of which the engine columns are being reconstructed. The modification is quite a simple one, and is being proceeded with as quickly as possible. They [the builders] have no doubt whatever about this modification being absolutely efficient and satisfactory." Four months have elapsed, and the boats are still at Malta. In these circumstances it is only natural that the Australian Press should be growing rather restive. It has now been announced that the repairs will probably be completed on September 8th, and that the boats should be ready for sea early in November. The seaplane carrier "Albatross," which was begun at Sydney in May, 1926, was launched on February 23rd this year. Compared with ships such as the "Furious," "Eagle," and "Courageous," she is very small, displacing only 6000 tons, and as her machinery is to develop no more than 12,000 H.P., the speed is likely to be moderate. It is understood, however, that her equipment for handling aircraft is of the most advanced type, and we are informed by Australian naval officers that she is expected to prove a most valuable adjunct to their fleet. She should be ready for service in the coming year, by which time the new cruisers and submarines will also have reached their station. Australia will then possess a small but compact fleet unit, which will constitute one of the main links in the chain of Empire defence. The recent decision of the Canadian Government to build two new destroyers suggests that Australia's fine example has not been without effect on the naval policy of other Dominions.

The Recovery of Waste Heat.

THE use of waste-heat boilers in connection with metallurgical furnaces has so often been advocated as a means of economy that the principle is liable to be accepted without examination. It is evident that the waste gases in general carry away a large amount of heat, and what could be more natural than to use this heat for steam raising, thus providing a cheap source of power for the forge or rolling mills which the furnaces serve? Put in this way, the case for the waste-heat boiler seems unanswerable. Furthermore, the undoubted economy which has accrued in many instances from the installation of such boilers might be taken to settle the question. The argument for the waste-heat boiler, however, rests on two assumptions. First, that there is enough heat going to waste to warrant the expense of special plant for its recovery, and, secondly, that there is useful employment for all the steam generated. To these may be added the belief that there is nothing better to be done with the heat. Because the steam is cheap, is no reason for using it wastefully. However much waste heat one has got, there is no justification for generating more steam than would suffice, with well lagged pipes and properly maintained machinery, to provide such power and warmth as the works may require. Nor is it good engineering to allow the capacity of a waste-heat boiler plant to be diminished by dirty boilers or ill-kept settings. All the heat which goes to the plant and all the steam produced by it should be efficiently used, for it is more economical to throw away the heat up the chimney in the first place than to dispose of it equally wastefully by the agency of a boiler. These considerations all tend towards the reduction of the waste-heat boiler plant to the minimum consistent with the supply of the necessary steam, and regardless of the amount of heat available. Again, the steam required in the works tends to become less and less. The great steam hammers of a generation ago are almost entirely replaced by hydraulic forging presses or electrically driven air hammers, while rolling mill engines are rapidly giving place to electric motors. Even though the electricity for the pumps and motors is generated in the works, it will require much less steam for its production than would have been necessary had steam power been directly used. The electricity, moreover, can hardly be produced except in a central engine-house, to which it is both inconvenient and wasteful to supply steam from waste-heat boilers scattered all over the place on account of their necessary proximity to the furnaces from which they derive their heat.

There is another, and a very suggestive, aspect of the question referred to by Mr. R. H. Stevens, the chief engineer of the Bethlehem Steel Company, in a paper on "Waste-heat Boilers" read recently before the American Iron and Steel Institute. The use of waste-heat boilers, as he points out, is an instance of an attempted solution of a problem which belongs to the wider field of reclamation in general. Man is ever trying to reclaim something. No sooner has a process or an apparatus become technically perfect, in the sense that its main product is satisfactory, than it is discovered to be wasteful, and efforts are directed to the improvement of its efficiency. Too often these efforts take the form of an attempt to recover the loss rather than to avoid it. Supplementary apparatus or a subsidiary process is introduced to reclaim heat, power, or material wasted in the main process, and we may be at the beginning of endless complications, each devised to abstract something from the waste of the previous one. It may be remarked that those attempts at improvement which consist in additions to existing apparatus are frequently little more than hindrances in the progress of design. The more successful they appear to be, the more strongly they point to the desirability of effecting such alterations to the plant to which they are applied as will check the waste at its source. A loss once incurred can rarely be more than partially recovered, and ingenuity will be better expended in developing the possibilities of the main unit than in seeking to palliate its existing defects. In considering the question of the application of waste-heat boilers to metallurgical furnaces, it must be remembered that the latter have, in principle, nothing to do with steam raising. Their function is to heat metal, and that alone. If all the heat in the fuel could be used for that purpose, the furnaces would be perfect. The more they approach this ideal, therefore, the better they are. The difficulty lies in the fact that the gases cannot leave the furnace itself at a temperature lower than that of the charge. In the case of a Siemens-Martin furnace, for example, the leaving temperature cannot be lower than about 2800 deg. Fah., and 3000 deg. Fah. may be taken as a more likely figure. If, by means of the regenerators, half of the heat in the leaving gases is usefully returned to the furnace, the gas temperature will be reduced to about 1600 deg. Fah. This would seem, in Mr. Stevens' opinion, to be about the upper limit of tolerable temperatures, having in mind that the primary object of producing heat at all is to use it in the furnace. If waste-heat boilers are to be employed, he also deprecates a higher gas temperature than 1600 deg. on the grounds that an impracticable amount of heat is left for the boiler to handle, supposing that the gases are finally to be discharged at a reasonably low temperature. On the other hand, if the temperature were to be less than 900 deg. Fah. after the regenerators, the gas would not contain sufficient heat to warrant the installation or the operation of a waste-heat boiler. Between the temperature limits mentioned the waste-heat boiler may be profitable, although not necessarily the best investment. Mr. Stevens, whose experience must be respected, would evidently like to do without waste-heat boilers at all, except when the steam can be used by the primary unit. His creed is to return waste heat, as heat, directly to the main unit, in so far as that can possibly be done. There are cases, when a finished product is necessarily discharged at a temperature far in excess of that desired or convenient, as, for example, in rolling mill or coke oven practice. In such instances the reclamation of heat by means of boilers is inviting since there is no possibility whatever of returning the heat to the process.

Ordinary metallurgical work is, however, on a different footing. Metallic recuperators are now available, which will deal with gases at temperatures of 1600 deg. or higher, and their installation, in connection with regenerators, may permit such a return of heat to the furnace that there is no scope for a waste-heat boiler. This would seem the ideal to aim at. The development of the very efficient metallic regenerators of the Ljungstrom type may assist in the solution of the problem. With regeneration and recuperation both carried out to the extent rendered practicable by modern knowledge and material, not only would the heat really wasted be very small, but the increase in furnace capacity, owing to the higher temperatures, would be considerable. As an example of what may be done, without going to extremes, Mr. Stevens quotes a case to show that the use of a high-temperature recuperator to deal with part only of the waste gases would enable a saving of 13 per cent. in the fuel consumption per ton of steel to be made, with a simultaneous reduction of the usual regenerator capacity by 20 per cent., and of the waste-heat boiler plant by 25 per cent., as compared with current practice. In addition to these advantages, the furnace capacity would be greater. At what point the increase in furnace temperature will put a stop to further advances along the lines of regeneration and recuperation is a matter which depends largely upon the makers of refractories and the designers of furnaces. It has been calculated that stack temperatures could be reduced to 778 deg. Fah. by returning heat to the furnace without raising the temperature of the latter above 3100 deg. Fah., which is about the limit imposed by existing refractories. The failure of the refractories would appear to be the real limit to the practicability of heat return. Until it is reached, the principle of putting waste heat back into the furnace is the one to follow, rather than that of using it to make steam which the process does not require.

Obituary.

WILLIAM ASHCOMBE CHAMEN.

As briefly announced in our last issue, the death of Mr. W. A. Chamen, for many years engineer and manager of the South Wales Electrical Power Distribution Company, took place on August 13th. Mr. Chamen was spending a holiday at Rhoose, and he died after a very short illness following a seizure.

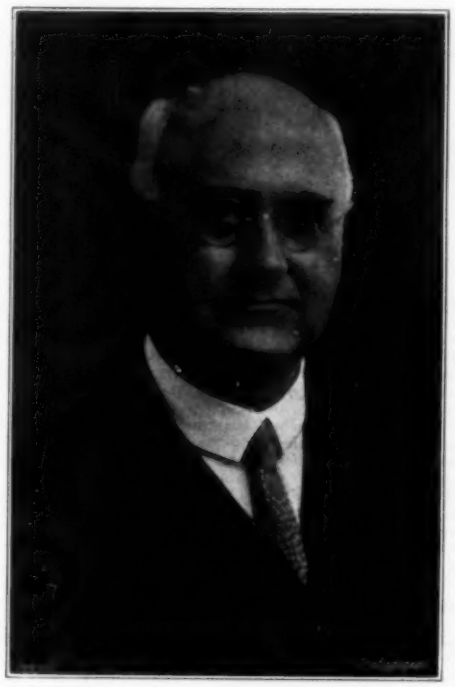
William Ashcombe Chamen, who was the son of the late Mr. C. T. de B. Chamen, was born at New Cross in 1864. His early education was obtained at Forest School, Walthamstow, and he subsequently gained his first experience in mechanical engineering at the works of James Gibbs and Co., Catdown, Plymouth. Quite early in his career he entered the service of Crompton and Co., Ltd., of Chelmsford, and he remained with that firm for some seventeen years. Starting at the works as an improver, he soon gave evidence of his capabilities, and was employed on outside works of importance. One of the first undertakings for which he was made responsible was the lighting, with arc lamps, of the King's Cross Station of the then Great Northern Railway Company. Thereafter he was sent to Munich to be in charge of the Crompton Exhibit at the Exhibition in that City. From there he was transferred to Italy, where he resided for some time, being entrusted with the laying down of electric lighting installations in several mills in Tuscany. On his return to this country he was put in charge of the equipment of the Law Courts for incandescent electric lighting. It was one of the largest electric lighting installations which had, up till then, been undertaken, and it was most successful. Other large lighting equipments of a somewhat similar character which he successfully carried out—though rather later later in his career—were those for the St. Pancras Vestry and the South Kensington Museum.

Subsequently, having in the meantime had charge of electrical machinery at the Forth Bridge Works, Mr. Chamen was made principal outdoor Engineer to Messrs. Cromptons. In that position he was responsible for the carrying out of numerous central station equipment contracts on which his firm was engaged, and, in some cases, had a good deal to do with the design of the stations themselves. Among these stations may be mentioned two for the Kensington and Knightsbridge Electric Lighting Company, Ltd., one for the Westminster Electric Light Corporation, and others at Barry Docks, Birkenhead, Dewsbury, Yarmouth, &c. He also was responsible for lighting works at the Liverpool-street Station of the then Great Eastern Railway Company and for the equipment of the electric railway on Southend Pier.

Another undertaking which he successfully completed was the electrical equipment of Southampton Docks for the then London and South-Western Railway Company.

In 1898 Mr. Chamen was made City Electrical Engineer of Glasgow. It was a position of great responsibility and he filled it ably. At the time, Glasgow's consumption of electricity was increasing by leaps and bounds, and in order to meet the demand, the creation of further generating stations became necessary. During his seven years' stay in the Scotch City he designed and erected the Port Dundas and St. Andrew's Cross Stations, and in both of them he embodied novelties which, at the time, attracted a great deal of comment.

In 1905 Mr. Chamen left Glasgow in order to enter into partnership with the Westminster firm of Consulting Engineers, Messrs. Bramwall and Harris, who were engaged in the design and erection of various power stations in different parts of the country, among them being that of the South Wales Electrical Power Distribution Company. For reasons which were not made public, the partnership did not last long, and in December of the same year he became engineer and manager to the South Wales undertaking, a position which he held till last year, when he was succeeded by Mr. J. W. Beauchamp, and given a seat on the Board of the Company. The condition of affairs when Mr. Chamen took charge were anything but encouraging, but under his capable direction matters were very greatly improved. In the year that he retired the plant capacity was 43,000 kW, the total



WILLIAM ASHCOMBE CHAMEN

connections to the distribution network represented 63,902 kW, the revenue from the sale of current was £283,619, and the working costs £192,429.

Mr. Chamen, in addition to being engineer and manager of the Power Company, practised as a consulting engineer at Cardiff, among his clients being the Rhymney Iron Company and the Swansea Harbour Trust. He was a member of the Institution of Mechanical Engineers, a Past-Vice-president of the Institution of Electrical Engineers—of which he had also acted as Chairman of the Glasgow Local Section and twice as Chairman of the Western Centre—a member of the Institution of Engineers and Shipbuilders in Scotland, and President, during the year 1924, of the South Wales Institute of Engineers, being the first electrical engineer to hold that office. He was also at one time a member of the Incorporated Municipal Electrical Association, and while in Glasgow he served for one year as President of that body.

Literature.

Alfred Yarrow: His Life and Work. By LADY YARROW. Popular Edition. London: Edward Arnold and Co. 1928. Price 5s.

IN June, 1923, we reviewed the original edition of this delightful book. The present issue is a replica of that work, saving in two particulars. One is that a short chapter describing the intimate characteristics of Alfred Yarrow has, by his own special decree, been omitted; and the other, is that a chapter entitled "Further Activities" has been added at the end. Our remarks on the present occasion will, therefore, be mostly confined to these two points; we may here repeat, however, what we said of the first volume:—. . . "it is not only a biography, but a history of a very eventful period in the development of our own and foreign navies. Lady Yarrow has done her work admirably, and we can assure any of our readers who may have doubts about the technical parts of her story that they will bear the closest scrutiny. The future may require that another 'Life' shall be written of Sir Alfred Yarrow, but the present work will remain unchallenged as a source of accurate information, and it is not likely to be excelled in lucidity and simplicity of style." We have seen no reason during the intervening five years to alter this opinion.

Lady Yarrow, though bowing to Sir Alfred's decision—which she describes as inexorable—to omit the chapter referred to above, has been unable to refrain from adding just a few words to take its place. One cannot help wondering whether the "Author's note" at the end was slipped in without Sir Alfred knowing anything about it! She boldly "claims the right, in this note, to mention one or two well-known and easily recognisable traits in the character of the subject of this memoir." We venture to quote at some length from what she says:—"With such a man as Yarrow . . . it would be strange if any record of his life could be accepted as adequate. How is it possible truly to describe the character of the man? It is impossible to satisfy the mind's eye, so critical, of the friend (and it is only for his friends that such a description should be written) who knows and loves every tone and gesture, every phase of the varied personality. How can words bring to mind the warmth shown in a single greeting, the sound advice given during some crisis in life, the comfort of a chat over some trial, the genial comradeship, the pleasant walk or dinner arranged to discuss some plan, the hand suddenly laid on the young man's shoulder, and, above all, the sympathy of an emotional nature for the wounded spirit or the suffering body? This book will naturally be read by people who have met, known and loved the one about whom it is written. But no words, however eloquent, could bring adequately before them the man who to many must ever stand out in memory as their best friend in difficulty and trouble; whose talent has ever been united to the power of showing sympathy in the most understanding manner, and who has left some trace of kindliness wherever he has dwelt."

Lady Yarrow does not do herself justice. Had she written nothing else, she has in those few sentences painted a wonderfully lifelike portrait, of which all who know Sir Alfred must appreciate the accuracy, while even those who have not that privilege cannot fail to gather from it some conception of the character of the man.

Of the chapter on "Further Activities" but little need be said. We learn that in May, 1923, Sir Alfred was admitted Fellow of the Royal Society, an honour which he greatly appreciated. The announcement is also made of the fact that Miss Eleanor Barnes—the authoress of the book—became Lady Yarrow in December, 1922; but that, it may be said, was common knowledge when the book first appeared.

Then there are notes concerning Sir Alfred's munificent presents of £100,000 and £30,000 to the Royal Society, and of £10,000 to the British Association. The gifts were the outcome of Sir Alfred's determination to make it possible for distinguished men to carry on investigations which otherwise would be beyond their means. The administration of the first gift was trammelled by no conditions; the Society was given an entirely free hand. With regard to the gift to the British Association, however, the stipulation was made that both capital and interest should be annually made use of and that the capital should be exhausted in twenty years. Sir Alfred, we learn, contended that that arrangement was more advantageous for the advancement of science than would be the use of the income only, in perpetuity, arguing that it was impossible to foresee in what direction money could be spent many years ahead to the best advantage, as changes so rapidly took place. To illustrate his point of view he quoted the fact that many years ago a legacy was left to buy faggots for burning heretics, which, he remarked, was clearly inapplicable now. Moreover, if the interest only were used, the entire capital would be at the bank when the world came to an end!

The Sales Engineer. By GILBERT RIGG. Mining Publications, Ltd., London. 1928. Pp. 112. Price 10s. net.

ON picking up this little volume one expects to find its contents entirely different from those comprised within its pages, for although the sub-title "Some Commercial Aspects of Metallurgical and Chemical Engineering" certainly limits the scope, we still have the feeling that the title is somewhat misleading, and should prefer to substitute "Experiences of a Sales Engineer," with the same qualification as at present appears. Having reconciled ourselves to a rapid change of idea, we shall not be disappointed by a closer acquaintance with the various problems that confronted the author in his capacity of sales engineer, deriving, not only interest, but instruction and inspiration from an insight into the manner in which he investigated and met his troubles. Mr. Rigg has a twofold desire in writing: first, to indicate the scope offered to the young engineer by sales engineering; and secondly, to emphasise the importance of having a fully trained man as intermediary between the company and the customer, one who can settle queries on the spot, rather than have to take refuge in the promise "I will report what you say to our Mr. So-and-So." The manner in which the author unfolds his theme will be more readily understood if the foregoing aims are borne in mind.

We are rather intrigued by the heading to Chapter I.: "Why is a Sales Engineer?" and as we read we learn that such a one should be a trained engineer, yet "if he ever makes any attempt to sell anything, he makes a mistake." In other words, a sales engineer is not a salesman. He will be called upon to act as interpreter between producer and purchaser, holding an even balance between them, always endeavouring to promote good will, and to do this he must never claim for the product something which he is not satisfied in his own mind is deserved. Should there be any complaint as to the goods supplied, the sales engineer will be on the spot in a minimum of time, conducting his investigation first-hand, and as a result either satisfying the customer that the charge was unfounded, or frankly confessing that there was justification for complaint, and proceeding to ensure complete satisfaction.

Chapters II. to VIII. give excellent descriptions of the author's problems in connection with paints, pigments, rubber, galvanising, zinc, and other analogous substances. While he is admittedly dealing with specialised products, the general principles and the methods of application are adaptable to a very wide field. When he says of galvanising: "The problems that arise in connection with this industry I am almost inclined to believe are everlasting," he will find a response from most engineers, who will be prepared to apply a similar sentiment to the particular branch with which they are concerned.

Chapter IX. deals with sampling and assaying, emphasising the importance of being able to clear up differences of opinion between producer and consumer in a scientific and convincing manner; though unless the sales engineer is able to take a pride in his goods and to demonstrate their value, he is not likely to make good.

The author's views on advertising in Chapter X. are distinctly entertaining, and when he commences by saying: "I wish to state now that advertising is completely and absolutely repulsive to me," we are prepared for what follows, and can almost sympathise with his feelings when a new and energetic sales manager decided to embark on an intensive advertising campaign, and included the sales engineer as a member of the advertising committee. His dignified protest was met by the requirement that "your job is to keep the advertising within shouting distance of the facts," and by carefully following this course he was able to save his company much embarrassment.

A short chapter on the activities of the American Society for Testing Materials—Chapter XI.—and another devoted to a summary and conclusions, with some accounts of a few odd jobs that fell to the author's lot—Chapter XII.—complete a very readable little book.

Evidently, the life of the sales engineer is replete with incident, and not unmixed with humour; but it is necessary to know the idiosyncrasies of the customer and to err in his favour when in doubt. On one occasion a complaint was received that a suit of overalls had been found in a barrel of zinc oxide, but a polite reply was sent that the firm could not afford to supply overalls at the price of zinc oxide, and any further overalls sent would be charged extra. In this case the "soft answer turned away wrath." In the midst of the advertising campaign to which we have alluded the company was claiming that a mixture of zinc oxide and white lead was the best protective coating for outside work, but at the same time the sales engineer found that the construction engineers of the same company were specifying for some work they had in hand "two coats of white lead." Thus, while the advertisement was pointing out the advantages of the combination, the advertiser was demanding pure white lead for his own work. Naturally, the sales engineer soon saw to it that the appropriate change was made in the specification.

Although the author touches but lightly on the training and qualifications required, it is not possible to read his book without forming a conception of his ideas on the subject, and the wider the training the more likelihood there is of success, provided there is also that close personal knowledge of his firm's products so essential when encountering an irate customer. Happy is the sales engineer who can "make friends both among the customers and the producing staff, so as to get the maximum of co-operation." It must ever be remembered that investigations in a customer's works may afford the sales engineer opportunities of seeing things that are not normally shown to the outsider. If he values the friendship of the customer he must strictly guard his secrets, and never divulge anything he has acquired thus in confidence.

We are in cordial agreement with the general sentiments of the author, and, if the relations between customer and manufacturer could be put on the high plane advocated, the value of the good will thus engendered would be incalculable.

IT is proposed to establish a modern waterworks system in Mukden.

Rotary and Turbo Compressors.

No. I.

In these days, when there is a marked tendency towards rotary machines in place of reciprocating ones, as evidenced in the continued development of the centrifugal pump and the steam turbine, it is not surprising to find that rotary air compressors are on a well-established footing.

Engineers have, of course, for many years made use of rotary machines for handling gas and air, but many of these are of quite small capacity. They operate on the displacement principle and are usually classified as blowers or exhausters, as the case may be. Moreover, they are worked at quite low pressure. Of late years there has been a good deal of improvement in their design, which has placed this particular type of machine on a footing well above that of the more or less rough-and-ready types used for such duties as supplying air to forges and for handling gas in gasworks, so that they come into competition with the small class of reciprocating compressors, over which they are often able to show some advantages.

The turbo compressor, which is, perhaps, better termed a centrifugal air compressor, operates on the same principle as that of the multi-stage centrifugal pump. It is not suited for very high-pressure work, but satisfies a wide range of pressure requirements from a few pounds, required for blast-furnace and similar work, up to the average 100 lb. pressure called for in the operation of mining and other air-driven machinery.

It has also been applied with considerable success in supplying scavenge air for two-cycle oil engines of large output. It is rather difficult to define the exact scope of the latter class of machine, as there are various types, and sizes for various duties, but its principal field is the supplying of relatively large volumes of air at low and moderate pressures, because, although its efficiency as a machine is not particularly high, it is very compact, it can be set on simple foundations, the moving parts are few, there are no valves, and it is suitable for operation by either a steam turbine or an electric motor.

Displacement Machines.

A common type of displacement machine is that shown in Fig. 1, known as the two-blade Beale exhauster. It is used for dealing with gas at gasworks to quite a considerable extent. From the diagram its construction and action will be clear. It should be pointed out, however, that the

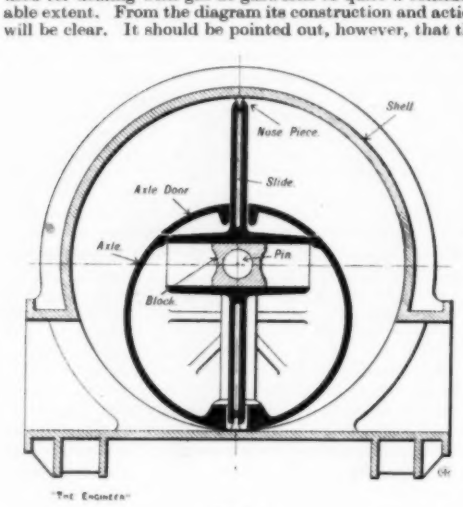


Fig. 1

shell is not circular, but is bored by a special machine to such a shape that the vertical diameter is equal to the chord struck horizontally through the centre of the axle, and therefore below the centre of the cylinder. This enables the double-ended slide to be in one piece, thereby eliminating the friction caused when the slide consists of two parts, one sliding relatively to the other.

The axle is cast in one with the driving shaft and slotted to receive the main slide. It is turned true on the outside and just clears the bottom of the cylinder. Doors are fitted into the axle to enable the slide with guide brackets cast on it to enter. These doors are locked in position by means of the axle door pins.

The main slide is cast in one piece with the guide bracket and has a slot at each end to receive the nose pieces, which are of malleable cast iron, fitted into slots in the slide, with springs to keep them out against the cylinder.

The guiding block is also of malleable cast iron and is surfaced to fit accurately between the guide brackets of the slide. In conjunction with the axle it entirely guides the motion of the slide, as is evident from the fact that this type of exhauster will run perfectly silently with the nose pieces removed, showing that the cylinder is not utilised in any way to guide the motion of the slide. In guiding the slide, this block rotates on the fixed pin, which is of forged steel, and is fixed in the non-driving end plate on the cylinder centre and above the axle centre.

The Rolling Drum System.

This is the essential feature of the Reavell blower, which is shown in Fig. 2. The action of the blades is similar to that of other displacement machines, while the rolling drum, which has a large number of holes in it, as shown, is an accurately machined cylinder running on roller bearings in the fixed end covers of the casing. The drum is quite free to rotate inside the casing, but it has a very fine clearance. Inside the rolling drum and running excentrically to it, an accurately machined rotor provided with the usual sliding blades is disposed. When the rotor begins to revolve, the centrifugal force generated in the blades causes them to press against the inner surfaces of the rolling drum, and as the latter is perfectly free to rotate it will be carried round by the pressure of the blades. As air can pass freely through the perforations in the drum, the compressing action goes on in the same way as if it did not exist.

The rotor shaft is mounted on ball bearings at each end. The rotor and drum being the only moving parts with the exception of the sliding blades, quite high mechanical efficiency is obtainable with these machines. Air enters through the suction inlet shown and is compressed by the reduction of the spaces enclosed by the rolling drum, the

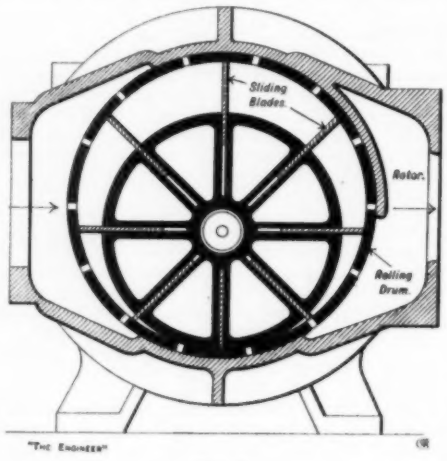


Fig. 2

rotor and the several blades, as the latter approach the delivery outlet on the side opposite to the suction.

This type of rotary compressor is in perfect balance, and having no valves is a highly efficient machine within its limits and must not be classed with a mere blower.

A type designed and built by the Swiss Locomotive and Machine Company consists essentially of a horizontal cylinder with the rotor mounted excentrically to the cylinder bore. The rotor is fitted with a number of radial blades which work in slots and move outwards against the wall of the cylinder when the rotor revolves. The action, in fact, is the same as any other type of compressor of this class, but, in place of the perforated drum of the Reavell type, the machine in question incorporates a pair of floating rings carried in the cylinder walls near each end against which the ends of the blades abut. These rings reduce the friction of the blades against the cylinder walls and permit a high peripheral speed—as much as 300 r.p.m., in fact. The rotor is made of cast iron and the main shaft is carried in ball bearings, while the blades, which are quite thin, are of hard sheet steel. The number fitted varies according to the size of the machine and pressure required. The inner diameter of the floating rings is made somewhat smaller than that of the cylinder, after taking into account elastic deformation due to heat effects and centrifugal stresses. The main idea, of course, is to reduce friction to a minimum, at the same time ensuring an adequate air-tight joint between adjacent cells. The floating rings must have an easy motion and are made with clearance on the outer diameter. In order to prevent leakage of air through this clearance a series of small blades fitted in grooves is fixed on to the floating rings, and a balance of pressure between the inner and outer parts of the rings is obtained by means of small holes pierced through them. The ends of the cylinder are closed by cast iron covers, which leave a slight clearance for any expansion of the rotor. The latter must, of necessity, be very small, so as to avoid unnecessary air leakage, which would detract from the efficiency. The bearings, which are disposed in the covers, are provided with stuffing-boxes having metallic packing.

Cooling is effected by a water jacket, which, in the case of units working intermittently, takes the form of a hopper.

The Turbo Compressor.

The turbo compressor was originally introduced in France by Rateau, as a development of the ordinary fan. Its evolution has been somewhat rapid, and the present-day machine has reached a stage of more or less standard practice.

It is not very long ago since a peripheral speed for the runner of 500ft. per second was looked upon as the practical limit, but, owing to the possibilities afforded by the use of alloy steels, speeds of as much as 800ft. per second are now met with. This is an important factor in obtaining a compact design, capable of giving pressures of 100 lb. and over—conditions which place the turbo compressor in a class outside the ordinary blower. For instance, if a tip speed of 900ft. per second could be used, about 50 per cent. greater rise of pressure might be obtained per stage, enabling a final pressure of 100 lb. to be built up in five or six stages; consequently, much depends upon the provision of material capable of withstanding such conditions.

In recent years diffusers have been added to such machines. As in the centrifugal pump, the main duty of the diffuser is to convert the velocity energy of the air, as it leaves the impeller, into pressure. Obviously, the higher the impeller speed, the greater is the issuing velocity of the air therefrom into the diffuser. In the earlier designs, diffuser blades were often absent, because their value was considered problematical, but it is now generally recognised that they both increase the efficiency and assist in producing a higher pressure rise per stage. The earlier system of cast iron blades, integral with the casing, led to a good deal of trouble, too; they set up excessive friction, owing to the difficulty of giving them a clean finish, while there was the mechanical difficulty of obtaining the exact form and angle intended by the designer This has

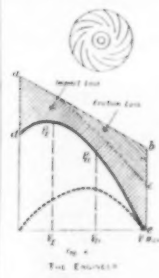


Fig. 4

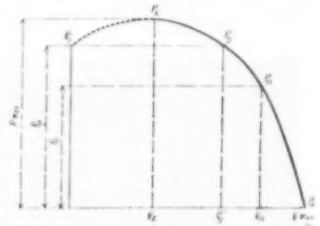


Fig. 5

led to the adoption of the diffuser ring as a separate portion of the casing, and this, together with the use of bronze, permits closer pitching of the blades, a more accurate form and a polished finish. Even with this arrangement, there is much to be desired, and the built-up diffuser ring consisting of planished steel or bronze strips, fitted in accurately machined grooves in the casing and blocked up with distance pieces, is now often employed with satisfactory results. By its use, it is certainly possible to obtain close pitching and accuracy as regards the entry angle, the latter being important because the smaller this angle, the smaller is the volume which any stage of a turbo compressor can handle.

The value of the diffuser blade, if properly constructed, can be seen from a study of the characteristics of Fig. 3, which shows curves relating to a machine without such blades, and also with them. It will be observed that the characteristic performance of the first type of machine,

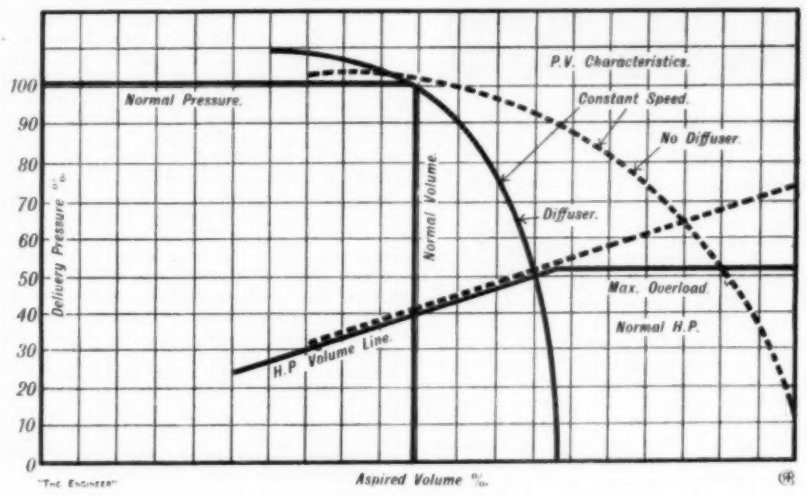


Fig. 3

as shown by the curve is what is termed a "flat" characteristic, the natural result of which is that, if the demand for air at any time exceeds the output for which the machine is designed, there is a gradual fall in the delivery pressure, resulting in considerable overload on the motor or other prime mover.

The full line curve shows the performace of a Reavell machine having properly designed diffuser blades. Both curves are drawn to the same scale, the pressure, volume and horse-power being expressed as percentages, the normal performance being taken in each case as 100 per cent. The relation between pressure and volume is clearly seen by the falling off of the characteristic, while the resultant increase of horse-power is shown by the rising horse-power line, the maximum thereof being reached at a maximum volume and zero pressure. In the old types this meant something like 75 per cent. overload on the motor. The steep fall of the characteristic curve in the case of the diffuser machine, however, shows that the maximum volume cannot exceed about 30 to 40 per cent. of the normal volume, and, therefore, the maximum over-

load which can possibly occur under these conditions will not exceed 25 per cent.

TURBO COMPRESSORS: BASIC PRINCIPLES OF OPERATION.

The fundamental principle of the turbo-compressor is that of the centrifugal pump and the form of impeller is virtually that of the single eye type of pump. The velocity given to the air by the revolution of the impeller is converted into pressure in the diffuser and increasing from stage to stage there is considerable evolution of heat, which involves a more or less elaborate cooling system. Of the types of blade which it is possible to use in the impeller, the backward curved one is that generally adopted, though for low-pressure work the radial blade is sometimes made use of, while the forward curved blade is hardly, if ever, used. In the diagram in Fig. 4, which relates to an impeller of the form indicated, *a b* is the theoretical pressure-volume curve, the area *a b c* represents frictional loss, while the area *a d e c* represents the impact losses. These inherent losses produce a drop in pressure from the theoretical, giving the actual P V curve *d e*. The efficiency of a turbo-compressor depends largely upon the skill of the designer in reducing these losses. In Fig. 5 is shown a P V curve for a compressor operating

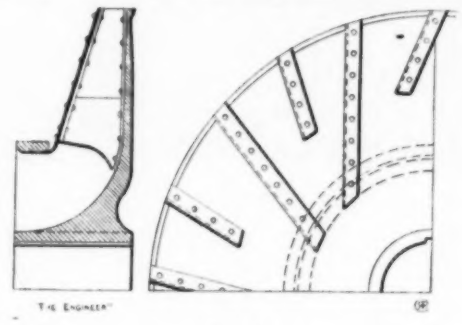


FIG. 6

at normal constant speed. From this it will be seen that V is maximum when P the pressure in the delivery main is minimum. As P increases, the volume of air aspirated becomes less, as shown by the normal point P *n* for a corresponding velocity V *n*. The maximum pressure is reached at the critical point P *x*, while if the volume becomes still smaller, the pressure again drops, the final value being P *y* when the indrawn volume is nil. In common with the centrifugal pump there is no excessive pressure rise if the valve on the delivery is closed. The point P *x*, the critical point, is so-called because it is correlative to a phenomenon peculiar to the turbo compressor known as surging or pumping. When the volume is reduced below V *x*, there occurs an intermittent delivery of air which sets up a pulsating noise, and this is apt to occur along the whole portion P *y* P *x* of the P V curve, and continuous operation within this range is impossible, except when the unit is equipped with devices to be considered presently, and stable operation is only obtainable along the falling portion of the curve P *x* P *o*, where an increase of volume entails a fall in the delivery

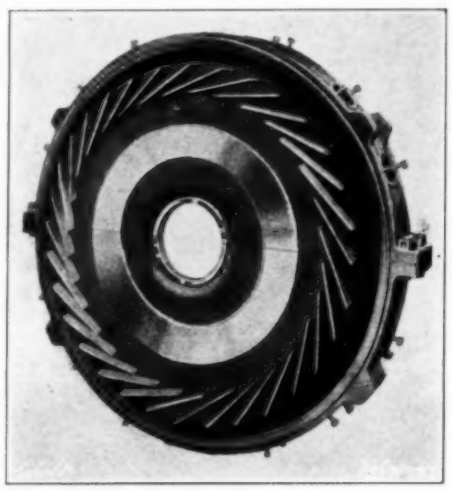


FIG. 7

pressure, and *vice versâ*. This peculiar action is due to a condition arising whereby the pressure in the main exceeds that in the delivery branch of the compressor, and air flows back into it. This surging or pumping is greatly influenced by the capacity of the compressed air system as a whole, but essentially it depends upon the position on the P V curve of the normal point P *n* with respect to the point P *x*. The further away P *n* is from P *x*, the later will surging occur. On this account when a machine has to contend with variable operating conditions, the normal point cannot be determined from the standpoint of maximum efficiency. Surging does not upset the delivery of air at the points of consumption, nor does it impair the operation of the machine. But in common with the centrifugal pump, the best operating results are only obtainable when the unit is delivering the intended volume of air at the stipulated pressure and running at designed speed. Practical conditions, however, render the maintenance of a constant volume often very difficult, and in order to ensure stable operation at reduced delivery, various devices may be resorted to, such as throttling the suction or providing a somewhat elaborate arrangement of blow-off valve. These are dealt with under the heading of "control." Suction throttling admits of stable operation being maintained practically down to the point of non-delivery, though the pressure falls rapidly when the volume is decreased below a certain limit, and its application is somewhat limited. The blow-off valve is effective, and is specially suitable for conditions in which the delivery pressure must remain constant, but it is obviously wasteful of power if the volume is in any way inconstant. A third arrangement is seen in the movable diffuser blade system of the Brown-Boveri design. It obviously adds to the cost of the machine, and must by its very nature entail a certain amount of added complication, as will be seen from the description presently.

TURBO COMPRESSORS.—CONSTRUCTION.

In Great Britain, the four principal builders of turbo compressors are C. and A. Parsons, Ltd., Daniel Adamson and Co., Ltd., Fraser and Chalmers, and Reavell and Co., Ltd., the last-named firm having developed comparatively small units, applicable to a wide range of duty, while the other firms handle a rather larger type, built principally for duty in iron and steel works. On the European Continent the Brown-Boveri design is well known. Single-stage machines of this type bear much resemblance to the centrifugal pump having a double suction, while there is the overhung type, which is a neat pattern for light duty.

Multi-stage machines of large output resemble multi-stage centrifugal pumps. Casings are, in some designs, built up of separate stages, located to each other by spigots and clamped up by through bolts, but, in addition, the complete casing is, as a rule, divided horizontally for ease of removal. Each stage is water jacketed, about which more will be said presently. This cooling is principally effective in the later stages of compression, owing to the fact that during the first two or three stages, the air, being at low density, does not readily transmit its heat. Low-pressure blowers, therefore, are often not water cooled. In construction, both impellers and diffusers have undergone a considerable change of later years. The former now usually consist of two steel discs with the vanes riveted between them, as shown in Fig. 6, one disc being spigoted into and riveted to the boss, so forming the back of the impeller, while the other, being coned at the centre, forms the inlet. In high-class work the discs are machined all over and taper in thickness from the centre to the periphery. This construction combines lightness with strength.

The guide vanes in the diffuser are usually of sheet steel, cast into two rings, which form the compressor diaphragm, as shown in Fig. 7, an Adamson design. These complete rings of guide vanes are machined to fit into the casing as complete units. It is common practice to use labyrinth packings between stages, and a thrust block is employed to take up end pressure, although it is quite a simple matter to arrange the machine to be practically self-balancing under certain conditions.

In modern water-cooled compressors, water spaces are formed between the wheel chambers and the cylindrical outer casing for the circulation of water, while, in the case of high-pressure machines, the diaphragms are made hollow for additional circulation of water. It is obvious that this entails a good deal of intricate foundry work, and for low-pressure work, at all events, it will often be convenient to dispense with water cooling, despite its advantages, as set forth presently, in favour of the simpler air-cooled machine, of which the Adamson-Rateau design, as shown in Fig. 8, is typical. Here the body consists of a number of cast iron diaphragms forming cells in which the

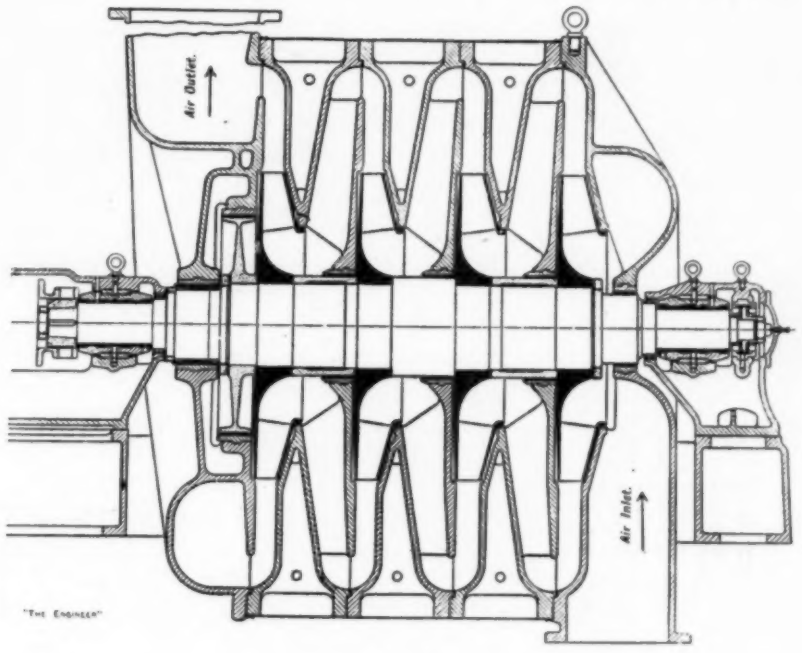


FIG. 8

wheels rotate. The outer diameter of these cells is considerably greater than the outer diameter of the wheels, so that they form with the outer chambers diffuser spaces, but considerably simplified by the omission of the usual water spaces.

In Fig. 9 is shown the system adopted by Messrs. Brown-Boveri in the construction of their impellers which are formed of alloy steel, while for compressors dealing with corrosive gases stainless steel is used. The impeller consists of the covering disc *a* with the inlet ring *b*, the hub disc *c* and the hub *d*.

The inlet ring and covering disc, as well as the hub and hub disc, are either forged out in a single piece or the two parts may be riveted together according to the stresses that have to be withstood in operation. The blades are riveted on both sides to the covering and hub discs. The rivet pins are milled out of the solid blading material and

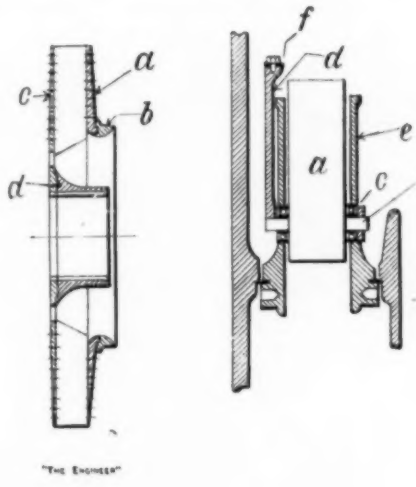


FIG. 9

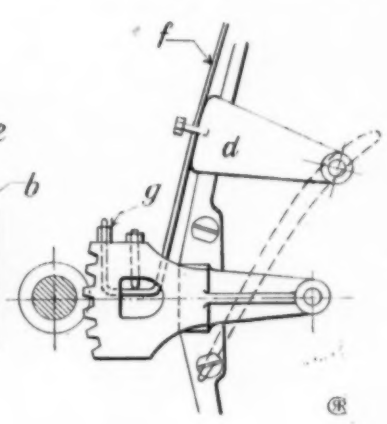


FIG. 10

thus form an integral part of the blades. This firm is also responsible for the previously mentioned movable diffuser blade. Of these there are two types. In the case of the first, known as fixed adjustable blades, the guide blades in the diffuser are not cast together with one of the facing rings as in the case of the more usual fixed blade, but they are manufactured separately. They are then assembled between the two rings in such a manner that they can be pivoted around their centres so that during the trials they may be adjusted as to position till the most favourable one to the particular conditions of operation is found. They are then riveted to the facing plates. The system of movable blades is indicated in Fig. 10. They can be operated externally by means of a hand wheel or a lever and can be adjusted at any time to meet changes in working conditions. The blades are of cast steel. They are carried by two machined cast-on pins *b* carried in the

ball bearings *c*, which are completely separated from the flow of air. The driving crank *d* is keyed on to one of the pins. The diffuser has again two facing rings *e* which are not split, however. For spacing the facing rings there are several fixed blades spaced evenly around the circumference. After the movable blades have been fitted the two facing discs are screwed together. The heads of the driving cranks *d* are rigidly united by the wire rope *f* connected at its extremities to clamps *g*, and by this means motion is given to them all in unison.

(To be continued.)

A Twin-screw Motor Ferry Boat for Egyptian Service.

We have received from Petters Ltd., of Westland Works, Yeovil, particulars of a new "N T" type of heavy oil engine for marine propulsion which has recently been put on the market. The new engine is more compact and has a smaller drop from the centre line of the crank shaft to the engine bearers than the standard "S" model, and for that reason it has been adopted for a 60ft. steel ferry for Egyptian Government service. A similar engine is being fitted into a tanker for the Sudan Government, which is being built by Aldous, Ltd., of Brightlingsea. Fig. 3 shows one of the twin four-cylinder engines for the ferry, which has a designed output of 36 B.H.P. at 600 r.p.m., the cylinders having a bore of 6in. and a stroke of 6½in. The overall length of the engine is 100in., its width 34in. overall, and its total height 42in., with a weight of approximately 28 cwt. The general lay-out of the machinery in the ferry boat is shown in Fig. 1. The machinery is placed about midships, and the power transmitted aft, through the reverse gear and thrust block by bronze propeller shafts of 2 7/16in. minimum diameter, to 24in. diameter outward turning four-bladed propellers. The stern tubes are carried out as far as the "A" brackets. From Fig. 3 it may be noted that the bedplate of the engine is extended aft to carry the reverse gear and thrust

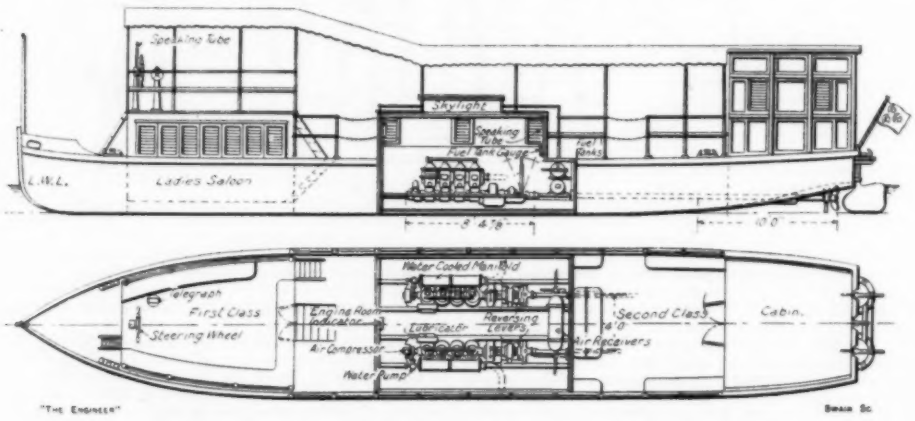


FIG. 1—ARRANGEMENT OF MACHINERY FOR TWIN SCREW FERRY BOAT

bearing, a fly-wheel being interposed between the engine and the reverse gear. The cylinders are manufactured and assembled separately as 9 B.H.P. units, so that either two, three, or four-cylinder engines can be built up, giving powers from 18 to 36 B.H.P. The standard "Petter" steel plate air inlet valves on the crank cases are retained, and the engine works on the two-cycle principle with airless fuel-injection. The crank case compression is about 4 lb. per square inch, and at the end of the exhaust stroke, when the piston uncovers the inlet ports, the air from the crank case enters the cored transfer passage, and is deflected by the specially shaped piston head to all parts of the cylinder, so that the burnt gases are effectively driven out and a new air charge given.

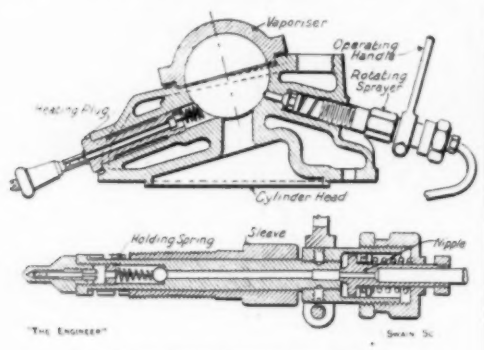


FIG. 2—CYLINDER HEAD AND SPRAYER

Compression then takes place to about 180 lb. per square inch, and the fuel begins to enter the cylinder about 35 deg. before the top dead centre is reached. The final combustion pressure in the cylinder is about 350 lb. per square inch.

In Fig. 2 we show the design of the "Petter" combustion chamber, with the electric heating plug for starting and the new rotating sprayer. The shape of the chamber is practically spherical, and it is joined to the main cylinder by a somewhat restricted passage. The purpose of this stricture is two-fold. First, it prevents any undue cooling of the vaporiser when the engine is running light, by partly deflecting the inrush of cool air from the heated vaporiser cap, and, secondly, it serves to increase the ordered turbulence of the mixture, and so promote good combustion

36 B.H.P. HEAVY OIL ENGINE FOR EGYPTIAN FERRY BOAT

PETTERS, LTD., YEOVIL, ENGINEERS

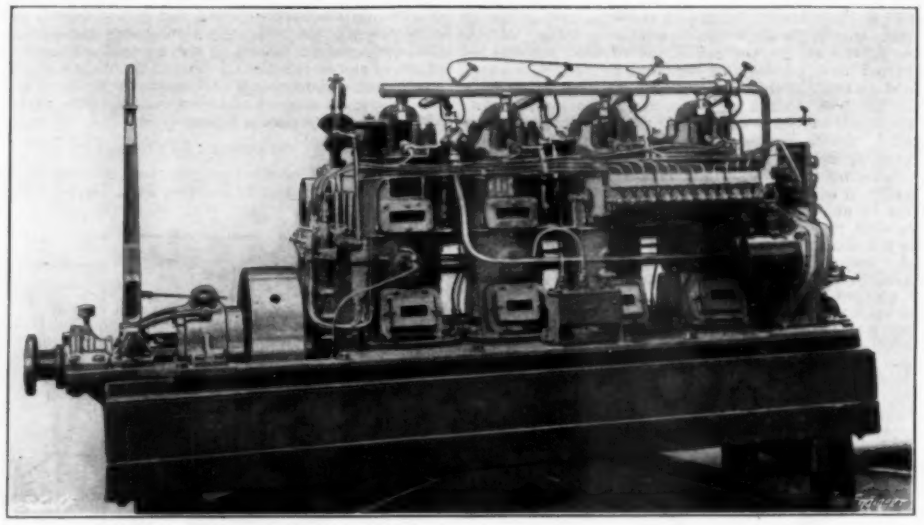


FIG. 3

conditions. In Fig. 2 the new rotating sprayer is shown. The design is such that by turning the handle through 180 deg. the fuel spray is deflected from its initial downward direction during starting, when the oil is sprayed on to the heated coils of the plug, to the normal working position in which the fuel is directed upwards to the top of the vaporiser. The section we give through the sprayer shows the arrangement of the flat spiral spring which is interposed between the sprayer itself and the sleeve surrounding it, and serves to hold the sprayer in a tight friction grip. Fuel oil is delivered through a nipple with a spherical seat, and a ball bearing and spring are housed within the nipple nut.

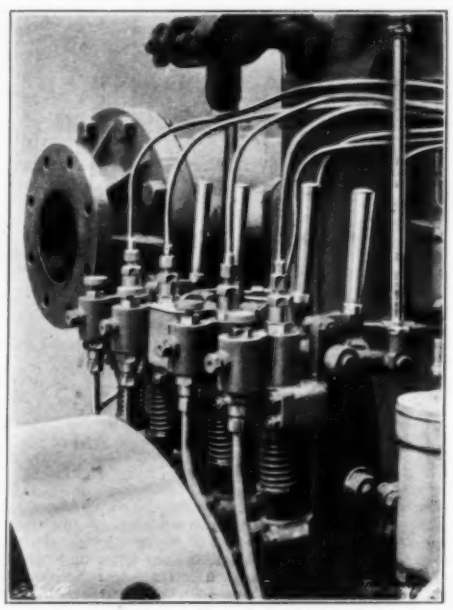


FIG. 4—FUEL PUMPS

When the operating handle is horizontal and is pointing to the left the spray is directed upwards. Referring to the drawing of the heating plug in Fig. 2, it may be noted that the body of the plug is water-cooled, and that the coil is housed in a recess which protects it from the direct action of the heat of combustion. Rapid starting blow-lamps are also fitted for emergency use, and in the smallest size of engine, "cartridge" type starters are used instead of electrically heated plugs.

Fig. 4 shows the fuel pumps, which are mounted at the fly-wheel end of the engine. Each cylinder has its own pump and the steel fuel pump plungers are of the glandless type, working in a manganese bronze body. The suction and delivery valves are of the ball pattern and a safety disc is fitted in the delivery side of the pumps to relieve undue pressure which might arise in the case of an obstruction in the delivery pipe. Arrangements are made whereby each pump can be cut out when desired, and a single control lever enables the speed of the engine to be varied within a wide range by limiting the return stroke of the plungers. The governor is of the double excentric type, the action of the superimposed excentrics being to vary the stroke of the pump plungers, and at the same time advance the fuel injection when the load on the engine is reduced. Forced lubrication is fitted throughout, and the oil is fed under pressure to thirteen points on the engine by a "Petter" "Calibrater" forced-feed lubricator,

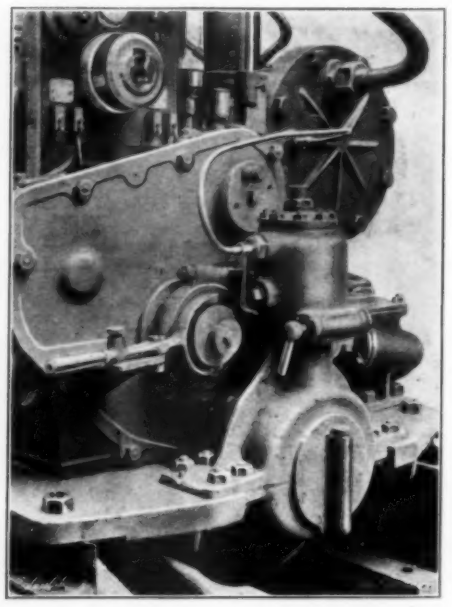


FIG. 5—AIR COMPRESSOR AND BILGE PUMP DRIVE

particulars of which were given in The Engineer of December 9th, 1927. The oil for the main bearings is in continuous circulation, and it drains from the bearing oil sumps into a special sump from which it is blown back to the lubricator supply tank by crank case air pressure.

Engraving Fig. 5 shows the forward end of the engine. At the top left-hand corner the switchboard for the 6-volt battery operated heating plug circuit is to be seen, and below it is the gear case enclosing the spur gear drive for the battery-charging dynamo, the rotary starting air distribution valve, and the starting air compressor. The compressor is directly coupled to the engine, but is only put into operation by the opening of an air port.

In order to economise as far as possible in the starting air, the firm's rotary distributing valve is fitted to the engine. Its function is to deliver air to the two starting cylinders in correct sequence. The other two auxiliaries driven from the engine are the circulating water pump and the bilge pump, both of which are of the double-acting plunger type. The circulating pump is worked from a crank placed on the inner side of the gear case, while the bilge pump—when fitted—is, as shown in Fig. 5, driven by an excentric forward of the gear casing and placed

between it and the starting air compressor. The excentric driving the pump is mounted on a loose sleeve, which is put into gear by the hand-operated dog clutch shown in our illustration.

The engine we have described is, we are informed, intended to meet the special requirements of small yachts and cruisers in which a compact unit with a small drop from the centre line of the shaft to the engine bearer is called for.

The Great Western Railway and the Export Coal Trade.*

By A. H. WAROM.

OUTSIDE the immediate area concerned, it is doubtful if the extent to which the welfare of the Great Western Railway Company is bound up with the prosperity of the export coal trade in South Wales is, even to-day, adequately realised.

At the present time that export coal trade is in the trough of a depression deeper than has ever previously been known; and what a few years ago was a highly prosperous business, giving employment to nearly a quarter of a million persons, and distributing large sums annually by way of dividend and bonus, has become practically insolvent, a large proportion of its pits closed down and with widespread unemployment, while its depressed condition reacts on every other industry, and on the material well-being of the whole district.

But while every industry and every class of the community are involved in the common suffering, the Great Western Railway Company, as the agency responsible for the conveyance of the coal from pit to port, and for its shipment at the latter, is, apart from the colliery owners themselves, the principal sufferer.

This will be the better appreciated when it is pointed out that the decline in the volume of coal—cargo and bunkers—shipped from South Wales ports during the twelve months ended April last, as compared with the corresponding period of 1914, amounted to nearly 8,000,000 tons. The average railway conveyance rate in South Wales, plus the charges incidental to weighing, tipping, &c., at the port, works out at approximately 2s. 6¼d. per ton, so that there is an immediate loss under this heading alone of roughly a million pounds, and to this must be added a reduced works and domestic coal consumption, estimated at about 3,000,000 tons per annum, together with reduced imports in pitwood and other colliery requirements, and, in addition, losses arising from the reduced spending power of the working population of the district.

It may be of interest under these circumstances to inquire what are the causes which, in the course of a few years, have reduced a highly prosperous industry to imminent ruin.

At the outset of the inquiry it is somewhat startling to discover that the statistics of the world's coal trade show a steady increase, both in production and consumption, and that contrary to a widely entertained opinion the heavy decrease in the South Wales coal exports is not due to diminished consumption abroad, the fact being that while coal production in competing coal producing countries like Germany, France, Belgium, and Holland, has increased, that of South Wales has receded.

Briefly, what has happened is that we have been getting a smaller share of the world's coal trade than we did in pre-war years, and unfortunately there is every indication that this disproportion will continue.

A well-known public man pointed out a short time ago that the depression in the coal trade was due to international causes as the result of wartime coal control, and that our customers in the Mediterranean, from whom, where post-war continental conditions gave us something in the nature of a monopoly, we extracted the last shilling for our coal, were driven to water power, which has since become a permanent competitor with British coals.

One factor in the reduced demand for Welsh coal, which has every appearance of remaining a permanent factor in the problem, is the substitution of oil for coal in the bunkering of the Fleet. This has caused the Admiralty to reduce its purchases of Welsh coal from nearly 2,000,000 tons in 1913 to less than 300,000 tons last year.

Another and probably the most important factor is concerned with the provisions of the Treaty of Versailles and the Dawes Reparation Scheme, by virtue of which agreements South Wales is suffering to a disastrous extent from the making of German reparation payments in the form of coal to France, Belgium, and Italy, more particularly to Italy. In pre-war days these countries were among the largest purchasers of Welsh steam coal for naval and railway purposes.

The extent to which German coal exports are being assisted by the Dawes Scheme—which was approved by the British Government—is but imperfectly understood, although it is the fact that Germany is now exporting coal to Italy at the rate of about 5,000,000 tons per annum, compared with less than 1,000,000 tons in 1913, and practically wholly at the expense of South Wales.

It has been estimated that but for the agreements mentioned, Great Britain would to-day be supplying coal to Italy at the rate of 10,000,000 tons per annum, while our actual supplies are at the rate of less than 5,000,000 tons.

It is the substitution of oil for coal by the British Admiralty combined with the partial loss of the Italian market that accounts in the main for the distressful state of the mining industry in South Wales to-day, so that the causes will be recognised as less economical than political.

There is yet another factor affecting adversely every British coalfield and South Wales more than most. That is in the rising spirit of nationalism evidenced in many European countries by a determination to become more self-contained, and as regards coal to supply their own demands, and to reduce the quantities required from Great Britain. Both France and Spain have sought by protective measures to develop their own fuel products and to restrict imports from this country, while in Holland a coal production of less than 2,000,000 tons in 1913 was increased to over 9,000,000 tons in 1927, and the output is still increasing, with the result that Holland is in a position not only to supply her own needs, but to become an exporting nation.

Nothing has been more remarkable in recent industrial history than the emergence of Poland as a coal-exporting country, and although its competitive activities are mainly concerned with Scandinavian markets, which before the war depended almost entirely on the South Yorkshire, Durham, and Scottish coalfields for their supplies, coal is to-day being forwarded regularly in competition with South Wales to France and Italy.

The output of the French collieries consequent upon the reconstruction of the mines in the devastated area steadily increases, while outside the Continent of Europe, countries whose coal production was formerly negligible are beginning to occupy a position of importance in the statistical tables.

If there be still another cause which has operated to the prejudice of this country's coal export trade, it will be found in the uncertainty of deliveries arising from internal strife in the industry itself, and particularly in the prolonged stoppage in 1926, a cause which on more than one occasion compelled our foreign customers to look elsewhere for supplies, and has had much to do with the development of domestic supplies in foreign countries.

From all this it is clear how closely interwoven are the interests of the Great Western Railway Company and the South Wales coal trade, and how the depressed condition of the one affects the material well-being of the other.

Even to the most optimistic the outlook for the coal export trade in South Wales cannot be considered encouraging. It would appear that probably for years to come there must be a permanent contraction in production, as compared with pre-war years, and that the economic recovery of the industry is only possible by a ruthless elimination of those high-cost collieries which can only continue to be worked at a prohibitive price, and a concentration on collieries producing a cheaply worked coal.

The South Wales coalfield has, however, two advantages with which Nature has endowed it for its economic salvation. These are, first, the best steam coal, and, secondly, as a consequence of the proximity of pits to ports, the lowest transport costs in the world.

* From the *Great Western Railway Magazine*, August, 1928.

South African Engineering Notes.

New Rand Gold-mining Ventures.

After being closed down for fifteen years, the Rand Collieries property, which adjoins the Brakpan Gold Mines, on the Far East Rand, is to be reopened as a gold-mining undertaking. Some time ago this company submitted a tender for the leasing of 2182 mining claims adjoining its existing property. It has now been announced that this tender has been accepted by the Government, and the additional sites will bring the company's total mining area up to approximately 3010 claims. The venture has excellent prospects. Formed originally as a coal-mining proposition, prospecting for the Main Reef series underlying the coal measures was undertaken, and a series of bore-holes put down gave the following results:—Bore-hole in north-western corner intersected reef at 2215ft., showing an average assay value of 26·8 dwt. over a stoping width of 48in. Bore-hole in north-eastern corner intersected reef at 3783ft., showing an average assay value of 20·6 dwt. over 48in. stoping width. Two shafts were sunk, and development operations up to December 31st, 1912, exposed ore amounting to 374,200 tons, value 5·3 dwt. per ton. A scheme for the reorganisation of the company is being prepared, and will be put through at the extraordinary meetings which have to be called for the purpose. There is no difficulty as to capital, as the parent company is the General Mining and Finance Corporation, Ltd. The new company will have a title more correctly reflecting its main object of gold mining.

On the West Rand there is also the prospect of an interesting revival. Mr. Arthur French, who presided at the annual meeting of the General Mining and Finance Corporation, stated that there is a reasonable likelihood of an amalgamation being arranged with the Durban Roodepoort Deep, Ltd., which will result in New Steyn Estate Gold Mines, Ltd., being brought into the sphere of active operations. This company's property comprises 1555 mining claims, a substantial portion of which, in addition to the Main Reef, also contains the Kimberley Reef series. There is a continuous stretch of over 5 miles on the strike of the reef. The original company was registered as far back as 1888, but active mining operations have never been commenced. The company has a capital of £300,000, and at December 31st the accounts showed an excess of liquid assets over liabilities amounting to £46,385. Leaving out of consideration this prospective amalgamation, it is safe to say that during 1927 and the first six months of 1928, the new mining leases granted, amalgamations formed—as, for instance, that between the East Rand Proprietary Mines and the Cinderella G.M. Company, which brought the latter into active operation—and the increased production of several of the big mines, have been of such extent that all the mines which will fall out of production through exhaustion of payable ore during the next five years or so will have practically no perceptible effect upon the annual gold production of the country, while the new mines will also ensure a substantial lengthening of the life of the Rand, over that which was estimated only a few years back. In all probability, the amalgamation referred to above will also take place. Several further leases are likely to be applied for, and, finally, there are very definite indications that at least two new goldfields of respectable extent may be expected to develop before long. A revival of activity in others, notably Barberton, may be looked for. New mining methods underground and new methods by which a greater percentage of gold is extracted from ordinary and refractory ores, are making it possible seriously to consider the reopening of mines abandoned through mining costs being too high and percentage of extraction too low.

More Engines from Germany.

Another South African Railway order for locomotives has gone to Germany. Seven narrow-gauge locomotives of the powerful "Garratt" type are urgently required for service on the Port Elizabeth-Avontuur line. The contract has been given to the Hanomag group of Hanover, Germany. The price for each locomotive is to be £4427 f.o.b. Hamburg, and delivery must be within twenty-two weeks. This tender was not the lowest. The lowest British tender was not among the first twelve lowest, being £5613 for each engine, or £1186 more per engine than the tender accepted. It is universally admitted that no matter how well disposed towards British firms, nobody could afford to give such a large preference to British manufacturers.

Progress of Beira.

The increasing importance of the Port of Beira, in Portuguese East Africa, is indicated by the recently published figures of traffic passing through the port. In 1924 the tonnage handled over the railway piers was 445,259. That figure was slightly exceeded in 1925, but owing to the floods in 1926 the tonnage fell to 388,649. Last year, however, there was a remarkable improvement, the provision of better facilities for dealing with cargoes having coincided with a large increase in the amount of traffic passing through the port. The tonnage dealt with over the railway piers amounted to 598,674, which is a record for any year. Since then four additional steam cranes on the lighterage wharf extension have been brought into service, making for the more expeditious handling of traffic at the port. Including traffic dealt with at the Customs wharf, the total cargo landed and shipped during 1927 amounted to 682,000 tons. Every year the total of ships entering the port is growing, the number during last year being 594, with a gross tonnage of well over two and a-half millions. Until some few years ago the inward traffic exceeded the outward, but since then exports have exceeded imports. Besides the exports from Rhodesia much of the copper from the mines of the Belgian Congo is shipped through Beira.

Record Traffic on Railways.

Record passenger traffic and goods returns are given in the latest bulletin issued by the General Manager of the South African Railways.

In March last there travelled on the suburban lines 5,742,198 passengers, an increase of 67,388 compared with the corresponding month of 1927. On the main lines and suburban sections of the Union and South-West Africa, the traffic included 6,812,974 passengers, being 92,860 more than the figures for March, 1927. During the year ended March 31st last, 81,654,870 passengers were carried on all lines, thus constituting a record, and representing an increase of 1,570,621 over the figure for the preceding financial year, when the previous highest number was recorded.

Goods and mineral traffic—other than coal—conveyed during March, 1928, totalled 882,507 tons, or an increase of 89,928 tons, compared with that of March, 1927. Altogether, there were 11,552,225 tons conveyed in the year ended March 31st, as against 10,496,596 tons in the previous twelve months.

In April, 1928, coal railed from Union collieries amounted to 967,189 tons, being 16,887 tons less than during the corresponding period of last year. The Transvaal and O.F.S. collieries' output during May, 1928, was 694,547 tons, 5536 more than in the corresponding month of the preceding year.

The total mileage route over which departmental road motor services were operating at June 19th, 1928, was 7438, and services involving a mileage of 2555 have been authorised. For the four weeks onded June 16th, 1928, railway earnings amounted to £1,902,595, representing an increase of £99,204, compared with the corresponding period of 1927.

THE IRON AND STEEL INSTITUTE.

As previously announced, the autumn meeting of the Iron and Steel Institute will be held in Bilbao, by invitation of the members resident in Bilbao and the neighbouring district. The sessions will take place at the Assembly Hall of the Alfonso XIII. High School, Bilbao, on Tuesday, September 25th, at 10 a.m., and on Wednesday, the 26th, at 3.30 p.m.

The subsequent arrangements include visits and excursions to the principal iron ore mines and iron and steel manufacturing and engineering establishments in the neighbourhood of Bilbao, as well as excursions to places of historic interest. An extended tour will also be made to Burgos, Madrid, Sagunto, Toledo, Cordova and Seville in the days immediately following the meeting.

The following is the complete list of papers offered for the meeting:—

(1) J. Balzola: "Iron Ore Mining in Vizcaya."

(2) C. A. Edwards and T. Yokoyama: "The Influence of Varying Strains and Annealing Temperatures on the Growth of Ferrite Crystals in Mild Steel."

(3) A. Herrero and M. de Zubiria: "The Phenomena of Corrosion of Iron and Steel."

(4) J. Orland: "The Influence of Pearlitisation Below the Ar_1 Point on the Mechanical Properties of Carbon Steels."

(5) J. G. Pearce: "The Use and Interpretation of the Transverse Test for Cast Iron."

(6) L. B. Pfeil: "The Change in Tensile Strength due to Ageing of Cold-drawn Iron and Steel."

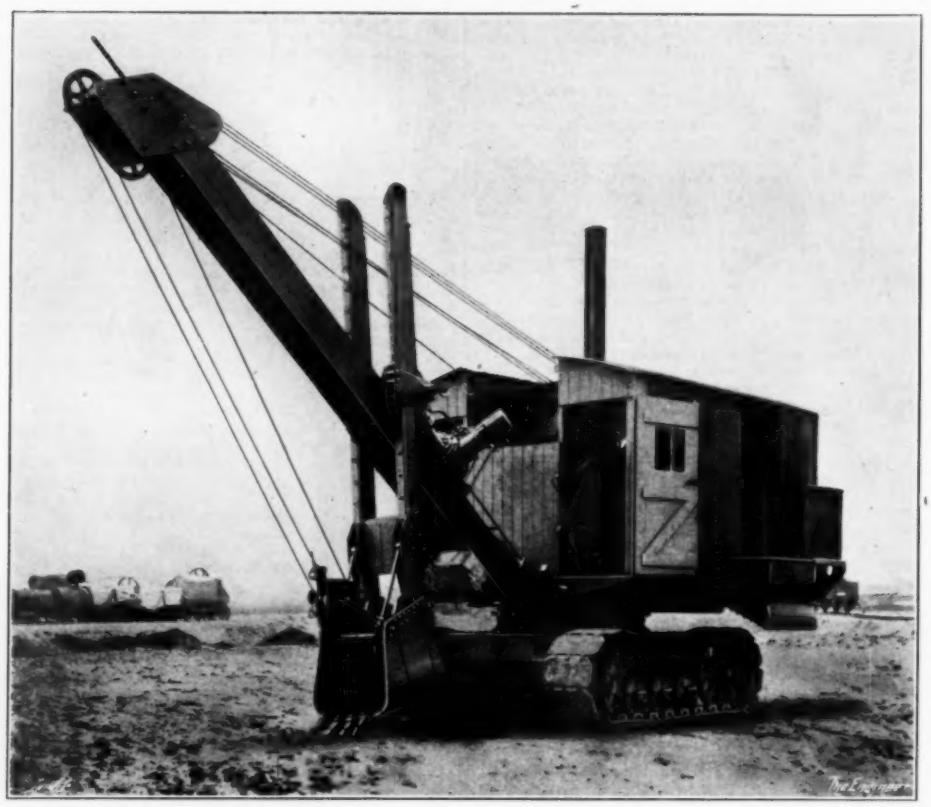
(7) S. H. Rees: "Some Properties of Cold-drawn and of Heat-treated Steel Wire."

(8) J. H. Whiteley: "Effects Observed in Quenched Liquid Steel Pellets and their Bearing on Bath Conditions."

THE railway companies would appear to be first adjusting their own business in order to meet road motor competition before going into road transport themselves. Very wide extensions of the single-fare-for-the-double-journey arrangements are announced, but the most interesting feature is the application of week-end fares to going on Friday and returning on Saturday. That was not done, even before the war. Their availability has been extended to Tuesday instead of Monday.

NEW TYPE OF STEAM SHOVEL

RUSTON AND HORNSBY, LTD., LINCOLN, ENGINEERS



A New Steam Shovel.

THROUGH the courtesy of the Gas Light and Coke Company we recently had the opportunity of inspecting at work one of the latest steam shovels made by Ruston and Hornsby, Ltd., of Lincoln. This machine, of which we give a half-tone engraving above, is chiefly noteworthy on account of the engine adopted, which is in each case of the V type. It may be as well, however, to give a description of the general arrangement of the machine before going on to the details of the engine.

As will be seen from the illustrations, the shovel is of the full circle type—that is, it can be rotated about a vertical axis continuously, with, of course, the exception of the undercarriage. The undercarriage is mounted on caterpillar tracks, which can be driven independently for steering purposes, and in this way the whole machine can be turned around in about its own length. Two speeds of travelling are provided—about half a mile and about three-quarters of a mile per hour. These speeds are provided by the gear wheels shown in the drawing Fig. 2, which, it should be pointed out, has been so arranged that all the shafts appear in the same plane, whereas, naturally, both the engine crank shaft and the track-driving sprocket axles are parallel and transverse to the main frame. It will be observed that after passing through the two-speed gearing the drive is transmitted through bevel gearing down through the centre post to a transverse lay shaft for driving the track sprockets. The connections at the ends of the lay shaft are through dog clutches which can be so engaged as either to drive the sprockets or to lock them to the fixed part of the framing. In view of the fact that the two clutches can be operated independently a very powerful means of steering is thus provided. The caterpillars have a base length of 8ft. and an overall width of 10ft., while the links are 2ft. wide, and the ground pressure is 0·82 ton per square foot. The propelling effort provided is sufficient to surmount a gradient of 1 in 6.

The underframe is built up as an exceptionally deep and stiff steel plate box, within which the travelling gearing is housed, so that it is well protected from dirt. Convenient doors are, of course, provided for access to the gearing. On the top of the box there is mounted a cast steel ring 5ft. 4in. in diameter for the support of the superstructure, which is carried by twenty-two cast steel rollers, 6in. in diameter. We noticed that although the shovel had only recently been put in commission on the occasion of our visit, there was a remarkably good distribution of load between the rollers, and it was evident that the machining of these parts had been carefully attended to. There is, of course, a post at the centre of rotation, and through this the travelling drive shaft and a water service pipe are carried. The rotating superstructure is built up of structural steel, while the jib is a box girder of autogenously welded plate. The dipper arms are flitched.

The machinery comprises two separate self-contained units and the boiler, which in the case of the latest models is of the horizontal type. The two units are the hoisting winch, with which there is incorporated the slewing gear and luffing motion, and the racking or crowding engine and its gear. The relative positions of these parts are well shown in the general arrangement, Fig. 1. The boiler has a working pressure of 125 lb. per square inch, a heating surface of 195 square feet, and a grate area of 7·1 square feet. About 30 lb. of coal is burnt per hour per square foot of grate, and approximately 6 lb. of water evaporated per pound of coal when working under normal conditions. The fire-door is in the side of the fire-box, so that the fire can be easily attended from the main footplate, and a feed-water heater, using the exhaust from the main engines, is installed in the uptake.

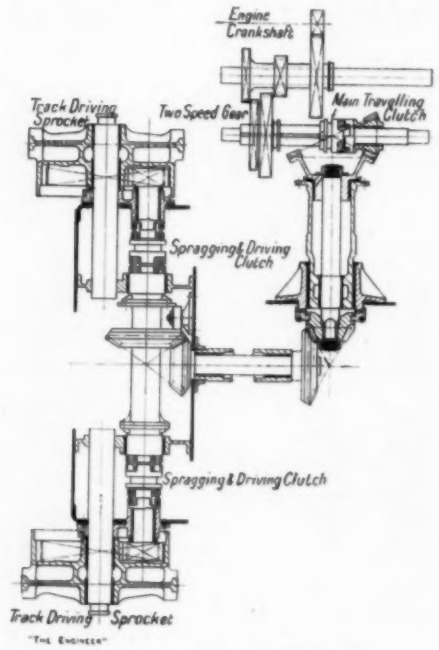


FIG. 2—DIAGRAM OF GEARING

The three engines are all similar in general dimensions and differ only in the means adopted for reversal. Each of them has two cylinders set at an angle of 90 deg., with a bore of 5in. and 5in. stroke. The moving parts are, as will be seen from Fig. 3, totally enclosed, so that they are protected from dirt and can be effectively lubricated, while the V arrangement of cylinders working on to one crank minimises vibration and completely eliminates the possibility of stopping on dead centres.

The main hoisting engine, which is that most prominently illustrated in Fig. 3—it should be pointed out that Fig. 3 represents a vertical-boiler shovel, although the engine is similar—drives the winch barrel, the travelling gear and the luffing motion. It is capable of developing 49 brake horse-power at a piston speed of 500ft. per minute. The steam distribution valves are of the piston type and both of them are driven off one excentric. In order to provide for reversing the engine a slot is cut across the

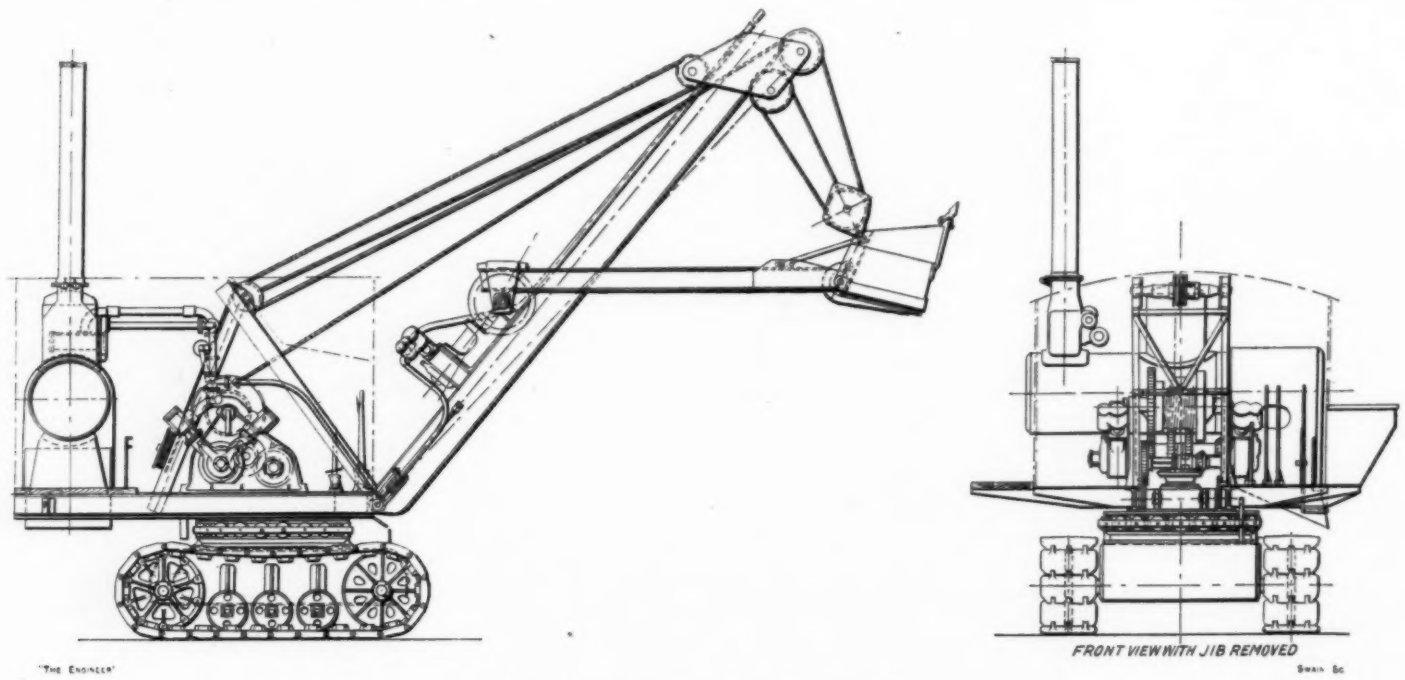


FIG. 1—ARRANGEMENT OF STEAM SHOVEL

excentric, and in this slot there is a block on an extension of the crank shaft. A worm, operated by a pinion and rack, enables the excentric sheave to be traversed across the shaft from the forward to the reverse direction. The lever for operating the rack is extended outside the crank case, as can be seen in Fig. 3, and is worked by rods reaching across the cab to the driver's station on the left.

The crank shaft has an overhung crank and is carried by a combination of roller and ball bearings. There is, besides the ordinary stuffing-box for the piston rod, another gland, which prevents any water trickling down the rod from gaining access to the crank chamber. Relief valves are provided on the valve chests to relieve the cylinders of any water of condensation or in the event of the boiler priming, and they discharge through pipes leading beneath the footplate. These valves can, if necessary, be lifted by hand levers. The wire rope for hoisting the bucket arm is $\frac{7}{8}$in. in diameter and has a threefold purchase. The pull exerted at the bale of the bucket is 8 tons at a speed of 74ft. per minute.

The slewing engine is mounted on the left-hand side of the winch framing and is similar to that just described, but is reversed by the simple expedient of changing the functions of the inlet and exhaust pipes. This arrangement, naturally, entails carrying steam for the full stroke of the piston, but as the engine is only used intermittently, while a rapid acceleration is a valuable feature in saving time, the consequent steam consumption is justified. The slewing engine is capable of rotating the shovel through an angle of 90 deg. with a full bucket in six seconds and through half a circle in 8½ seconds.

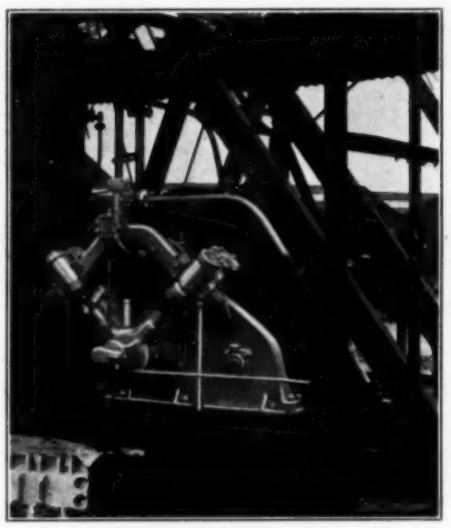


FIG. 3—MAIN HOISTING ENGINE

The machine which we explored at Beckton was equipped with an unusually large bucket, as it was being used to handle light material, such as breeze and rubbish; but it seemed, nevertheless, to be very handy, and loaded wagons with several buckets full quite gently and evenly, while the driver appeared to have easy and full control of all the movements.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR HERBERT CHATLEY, D.Sc. (Engineering), M. Inst. C.E., has been appointed Engineer-in-Chief to the Whangpoo Conservancy Board, Shanghai, *vice* Captain H. v. Heidenstam, M. Inst. C.E., who has resigned.

JANAIR, Ltd., asks us to announce that its registered office has been removed from 61, Stanmore-road, Edgbaston, to Shenstone Station, near Lichfield, to which address it is requested that all communications should, in future, be sent.

ALEXR. CHAPLIN AND CO., Ltd., of Cranston Hill Engine Works, Helen-street, Govan, Glasgow, S.W., ask us to announce that they have appointed Mr. Anderson Rodger, 38, Victoria-street, Westminster, London, as their sole representative for London and district.

THE PLENTY-STILL OIL ENGINES, Ltd., is the name of a company which has been formed to take over the oil engine interests of Plenty and Son, Ltd. For the purpose, the new company has reconstructed, enlarged, and equipped the King's-road Works, Newbury, the *personnel* of the staff being the same as was in charge of the oil engine department of Plenty and Son, Ltd.

AGRICULTURAL AND GENERAL ENGINEERS, Ltd., of Aldwych House, Aldwych, London, W.C. 2, asks us to announce that, in order to co-ordinate the Australian interests of its fourteen associated companies, it has appointed Mr. A. Simpson, formerly H.M. Trade Commissioner in Sydney, to act as its resident chief representative in Australia. Mr. Simpson's appointment will in no way interfere with any existing agency arrangements.

ALUMINIUM PAINT.—We have received from the Northern Aluminium Company, Ltd., of Bush House, London, W.C. 2, a booklet which emphasises the merits of powdered aluminium as a pigment for general painting purposes, and discusses some of the characteristics of the material not generally recognised. It is explained that aluminium powder for painting purposes is not granular in form, but, that by a process of punching, it is given a minute scale-line formation. These scales are polished, and then the surface tension of the vehicle in which they are suspended makes them all lie flat near the surface of the fluid. The result is a continuous surface of interleaved particles cemented together, which provides a remarkably efficient protection for anything beneath. The powder may be mixed in various vehicles, but the mixing should be done daily, as the mixture tends to loose its "leafing" characteristic. Apart from its decorative qualities aluminium paint is excellent for its damp-proofing qualities, and its resistance to the permeation of stains. It is said to be far superior to shellac for the covering of foundry patterns.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

State of Trade.

HOPES for a prosperous autumn season are increasing in trade circles in the Midlands and Staffordshire, and this week inquiries have been circulating on the Birmingham iron and steel market in view of anticipated orders. The various, and fairly numerous, contracts which have been placed with Midland engineering firms since the August holidays give manufacturers of raw material ground for optimism. They entertain the belief that business will be materially augmented in the near future. Many firms are awaiting the result of tenders for important works which were submitted before the holiday break. Engineers engaged in the production of railway rolling stock have very fair order books, and are trusting to the home railways for some business ere long. The major portion of the work on which they are at present engaged is on export account. Some good steel orders should be forthcoming from this branch of the engineering industry shortly. Constructional engineers are not well situated for orders at the moment, and their demands upon the iron and steel works are small. Motor engineers are also taking less material, their season having now come to an end. Makers of commercial vehicles, however, are still busy, and in some cases the orders on hand will keep the works fully occupied for the next few months. The electrical section of the engineering trade is still the busiest, and orders from this source are regular, if of comparatively small content. A brighter tone was noticeable on 'Change in Birmingham to-day—Thursday. The market assumed a more active appearance, though buying and selling were not up to the general standard of business. Many consumers of iron and steel, alike raw and finished, have sufficient material in stock or on order to satisfy immediate needs, and they wish to survey the position thoroughly before entering into fresh contracts. From the nature of inquiries, it would seem as though some manufacturers were contemplating the placing of forward orders, and producers appear willing to meet them in the matter of price. Such business is most desirable at the moment, and if negotiated would add considerable confidence to the market. Supplies are plentiful in all departments, and blast-furnacemen have considerable stocks at furnaces. The orders recently placed in this district by the Colonies suggest that some of our old customers are gradually recovering their pre-war financial position, and may be regarded as prospective buyers.

Pig Iron.

The pig iron position causes disappointment, but the decline in value has apparently now reached its limit, and there is a general expectation of improvement in the autumn. There is no anxiety regarding supplies, it being recognised that even with the recent stringent restriction of output, the furnaces remaining in commission are in many cases capable of a larger production than they are at present turning out. Moreover, there are considerable stocks at the Midland furnaces to be absorbed before any quickening of demand can have much effect. The action of furnacemen, particularly in Scotland, in blowing out furnaces suggests that they have reached the conclusion that the depression is deep-rooted, and that a revival of demand in the autumn is not to be looked for. In this district there is no sign of renewed activity at the foundries or forges, and the outlook is certainly far from cheerful. Though the output of foundry pig last month only amounted to 130,000 tons, there can be no doubt but that it was much in excess of consumptive demand. A similar state of affairs exists in the forge branch, the output being no more than 23,200 tons; yet there are stocks on which to draw. There is a better demand in this district for basic pig than for forge or foundry material. With prices of pig iron no more than upheld, and abundant stocks to draw upon, consumers are not disposed to enter into forward commitments in anticipation of autumn requirements. Foundrymen are, however, keeping a very watchful eye on the market. They are anxious not to miss the opportunity of securing cheap supplies of pig iron if there is any prospect of things mending. For the small-scale business which is being offered, quotations rule on the basis of from £2 19s. to £3 for Derbyshire No. 3, and £2 15s. upwards for Northamptonshire at furnaces. Only occasional sales of forge pig are being effected, and prices are variable. Hematite sells slowly, East Coast being about £3 7s. 6d.

Manufactured Iron.

The Staffordshire finished iron industry is moderately employed, but conditions vary considerably in the respective branches of the trade. Rollers of best-grade bars are in the best position, having relatively good order books. The price of marked bars remains firm at £12. Business is spasmodic in the Crown bar branch, orders coming through fitfully and being secured against strong internal competition. Prices range from £9 2s. 6d. to £10, while a few specially favoured Staffordshire firms ask £10 5s. for their products. Common bars for nut and bolt and fencing purposes are in poor request, but less continental material is being ordered, and local ironmasters anticipate increased business. On the other hand, makers of nuts and bolts are said to be anxious to resume buying from Belgium. At date there is only a little attraction about continental supplies. Belgian No. 3 iron is quoted £6 17s. 6d. against local makers' price of £8 15s. upwards. The question of delivery weighs heavily against the foreigner just now. It is considered that Belgian No. 3 iron is likely in the near future to go up to the high figure of £7 per ton, if not more; hence the inclination on the part of habitual users of this class of material to lay in stocks. The continental position is likely to give district mills an even better opportunity of securing business than they have had of late; consequently Staffordshire ironmasters may reasonably hope for, at least, the continuance of the present qualified activity at the mills. Wrought iron gas tube strip is in only fair demand, and sellers have some difficulty in maintaining the price at £10 15s. Keen competition is reported for each and every order which comes on to the market.

Steel.

There is no new development in the steel department. The firmness of continental prices continues to help British mills to retain the trade they have recovered this year. Steelmaking operations in this district range from half time to full time, but the output is small in proportion, owing to the lightness of tonnage of individual orders, which involve much waste of time in roll changing. The orders for structural work being received are rather slow and are unevenly distributed. In this, as in certain other branches of the finished steel trade, local plants are securing a fair share of the business going. It is stated that the bulk of the steel now being used for structural work is of native manufacture, but it is understood that foreign joists, which still offer a little price advantage, are being utilised to some extent. Some of the strip mills have had more difficulty in making up their rolling programmes lately. This is not altogether unrelated to intensified foreign competition. There is no change in prices, angles and joists being quoted £7 17s. 6d., less rebate to those using English material exclusively. Ship, bridge and tank plates make £8 12s. 6d., and boiler plates £11. Staffordshire hoops are £10 10s. at works. Small bars range in value from £7 7s. 6d. to £7 17s. 6d., according to whether they are rolled from foreign or native raw material. Mild steel billets are quoted firm at £6 2s. 6d.

Galvanised Sheets.

The market for galvanised sheets still drags. Most of the mills have cleared off arrears of orders, but not all. For 24 gauge £13 7s. 6d. to £13 10s. remains the selling price. Unfortunately, makers of galvanised sheets are not doing anything like so well as last year. Sales to foreign buyers in July were between 2000 and 3000 tons below the June total.

Rapid Erection of Steel Lattice Poles.

An interesting demonstration was recently given in connection with the overhead transmission line now being erected for the Shropshire Electric Power Company. The power line is being erected to convey current from the Stourport electric power-house of the Shropshire company to Bridgnorth and district. The poles for carrying the power line are of the steel lattice type, and up to quite recently the usual practice has been to erect the poles in sections. The demonstration given was raising one of the poles completely equipped from a horizontal position on the ground, and the work was accomplished in one and a-half minutes from start to finish—that is, the pole was hoisted and bolted down. For the purpose, shear legs and a new six-wheeler commercial vehicle were employed. The steel lattice pole was close on 60ft. in height, and weighed approximately 3 tons. The demonstration took place in the neighbourhood of the village of Alveley, between Kidderminster and Bridgnorth.

Large Order for Birmingham Firm.

I learn this week that an order to the value of nearly £150,000 has been secured by the General Electric Company, Ltd., of Witton, Birmingham. The order is for the supply of 102,500 yards of electric cable—33,000 volts—for the electricity scheme of the Sydney Civic Commissioners. The contract also includes the supply of a pilot cable, 101,000 yards in length, and the necessary jointing materials.

Unemployment.

The unemployment returns for the Midland area again show an increase as compared with the total for the week prior to the Bank Holiday. This, however, is largely due to the motor production season being in the last stage. Generally speaking, unemployment in the motor trade is said to be higher now than it was in August, 1927. In the Birmingham area there is an increase in unemployment since July 30th of 1315: Stoke-on-Trent area, 6281; and Wolverhampton, 1304. The total for the Midland area now stands at 217,443, as against 204,012 at the end of July.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Colliery Amalgamation Scheme.

MUCH interest has been aroused in the heavy industries locally within the past few days by the publication of the outline of a proposed scheme for the amalgamation of three of the leading colliery companies in Lancashire—Bridgewater Collieries, Ltd., of Walkden, Manchester, Astley and Tyldesley Collieries, Ltd., Tyldesley, near Manchester; and Andrew Knowles and Sons, Ltd., Pendlebury, Manchester, all old-established concerns, and all on a dividend-paying basis during the difficult times of the last few years. The combined ordinary share capital of the three concerns is in the neighbourhood of £2,500,000, and altogether employment is provided for about 11,000 men. At the moment of writing no further information as to the terms of the proposed merger is available. The advantages of the scheme from the point of view of economy in production costs, more particularly as the pits of the three companies are in relatively close proximity, are obvious, and already hope has been expressed that one result, if the proposal matures, may be a reduction in the price of fuel for both industrial and domestic purposes.

Constructional Engineers' Good Order Books.

Industrial peace was advanced by Mr. G. W. N. Nicholls, deputy chairman of Edward Wood and Co.,

Ltd., constructional engineers and ironfounders, of the Ocean Ironworks, Trafford Park, Manchester, at the annual meeting of the company, as the chief reason for the improvement in the firm's business. So far as the company itself was concerned, there had, said Mr. Nicholls, been a complete absence of unrest, and that condition of affairs was, he thought, due to the consideration shown to, and by, all grades of employees. "Trust the workmen" should be our slogan. Without that confidence we shall never regain the markets which were lost during the war. Stability of labour will do much to restore the pre-war standard of our export trade, which at present is almost negligible; and when labour conditions abroad are raised to the level now operative in England, the unfair competition at present prevailing will be eliminated. There is every indication of an expansion of the business during the present financial year. The present position of the order books is good, and although prices are still exceptionally keen, our increasing turnover should enable us to forge ahead."

Lower Electricity Production Costs.

From every point of view a marked improvement over the preceding year is disclosed in the annual report, just issued, of the chief engineer to the Salford Electricity Committee. There has been a marked decline in the working costs of the undertaking, revenue has shown an equally marked expansion, the production of current has attained a record, the net profit is on a higher scale, and all-round reductions in the charges to consumers of electricity has been adopted. The revenue for the year reached a total of £318,823, or an increase of 9·5 per cent., whilst the total working costs at £157,924 represented a decline of 16·5 per cent. To some extent, of course, these improved results are due to the much lower prices that were paid for fuel compared with the previous year when operations were influenced by conditions arising out of the mining dispute. Out of the net profit of £55,663, £21,713 has been allocated to the reserve fund, £18,950 for capital expenditure charged to revenue, and £15,000 to relief of rates. The total number of units sold was 60,696,636, and for the first time the cost of production fell below a penny a unit.

Non-ferrous Metals.

Conditions in the market for non-ferrous metals this week have been somewhat inactive, and there has been no noteworthy feature to report in any section. Buying interest in copper has been on moderate lines, but although on balance for the week there has been a loss, it has been almost infinitesimal. There is no doubt that in this section of the market the statistical position is strongly in favour of holders of the metal, and it is anticipated that any improvement in the demand from consumers will be accompanied by a definite firming up of prices. In the case of tin current production on the present basis is more than sufficient to meet the demand, and the price outlook continues very uncertain. From the extremely low point touched at the beginning of July there was a steady recovery until towards the end of the month, but since then weakness has been a feature with a gradual but steady decline. The loss compared with a week ago is about £1 a ton. There has been a fair amount of buying going on in lead, and although there has been no further advance, prices show every indication of remaining firm for the time being. With regard to spelter inquiry has not been particularly active, but values have been maintained on a somewhat more reserved attitude adopted by holders.

Iron and Steel.

After a slight spurt last week in business transacted in foundry iron, due to the placing of one or two forward contracts by favourably-situated users, conditions have shown signs of relapse, and this week buying interest has been slow again. Sellers, however, are not without hope of a definite improvement when the holiday season comes to an end. Meanwhile, prices of all varieties of pig iron keep fairly steady, Staffordshire and Derbyshire makes being quoted at about 67s. 6d. per ton, Middlesbrough at 79s., Scottish at 87s. 6d., and hematite iron at 81s. 6d. to 82s., all for delivery Manchester or equal distance. A quiet trade is passing in finished iron at £10 per ton for Lancashire Crown bars, and £9 10s. for seconds. In addition to the usual demand for constructional steel, which has been about up to its recent level this week, rollers have met with some inquiry for boiler plates locally from makers of Lancashire boilers, as well as from the locomotive building industry. Firmness characterises almost every section of the steel market, re-rolled bars being quoted at about £7 15s. per ton, large bars at £8 17s. 6d., general plates at £8 12s. 6d., boiler plates at £9 12s. 6d. to £9 17s. 6d., and joists and sections at £7 17s. 6d. For foreign steel materials the orders that are being placed on this market are for small parcels in almost every case, but in spite of this prices are well held. Joists, for delivery to Lancashire buyers' works, are quoted at up to £6 2s. 6d. per ton, angles at £6 15s., Siemens plates at £8 2s. 6d., steel bars at £6 17s. 6d., sheet bars at £5 15s., and billets at £5 10s. to £5 12s. 6d.

BARROW-IN-FURNESS.

Hematite.

There must have been a certain amount of confidence among the iron producers in the district, otherwise they would have restricted their output some time ago. The improvement is due in a few weeks if the opinions of some are to be taken as a sign of better things. Certainly the position, as far as production is concerned, has been eased by the fact that both the steel departments at Workington and Barrow are now producing railway material, and, as a consequence, are taking a considerable amount of iron each week. There has been a slight easing in price, and the reduction no doubt has been made with a view to clearing stocks and encouraging trade generally. At present the signs of a real improvement are not very noticeable, but it is too early after the holidays to express an opinion as to what may be expected in the future. Customers are still content to keep their orders down to a minimum and are not inclined to place orders for forward delivery. Overseas trade is not big at present, and American business is dull. The iron ore trade is moderately employed, and the Cumberland mines are doing a little better than they did a few months ago. The steel trade is quiet, but both Barrow and Workington have accumulated orders during the months they have been idle which have justified the starting of the rail, merchant and sleeper mills again. The hoop works at Barrow are well situated.

SHEFFIELD.

(From our own Correspondent.)

Dull Conditions Continue.

THERE are cheering reports, of a general character, that autumnal demands in the iron market are likely to be good, and that inquiries are coming along earlier than usual. Sheffield sincerely hopes that these forecasts will be fully justified, for its industries, apart from those of a special kind, have been under a cloud long enough, and at present there is little sign of that cloud lifting. For several months the volume of work in the steel and allied trades of the city has shown little variation, and it is far below the capacity of the works. Some little improvement can be recorded in the basic steel section, where makers are booking increased orders owing to continental prices having risen whilst local quotations have not been changed. The amount of work, however, is only moderate. So far as the better-class acid steels are concerned, trade can only be described as bad. A ground of hope is afforded by the fact that stocks in the hands of consumers must be very low. There has been such a paucity of buying for some time that further supplies will be wanted before long, and even a slight increase in the demand for finished goods would mean an immediate call for supplies of raw and partly manufactured materials.

Railway Work.

One of the causes of the slackness in the acid steel department is the shortage of orders for railway materials. The British companies have been carrying out a very economical buying policy for the greater part of this year, and it is expected that before long they will have to give out large specifications for the replenishment of stores and worn-out stock The export figures for July showed a fall in rails and railway material, as compared with both June this year and July of last year. As regards railway wagons, there were improvements in trade with the Argentine and South Africa, but these were nearly balanced by a loss of Indian work.

Other Departments.

The only really busy branches of trade in Sheffield are those which deal with special lines. Of these, stainless material continues to be one of the strongest. The demand for high-speed and alloy steels, as a whole, is far from satisfactory, but it is pleasant to know that the exports of these materials last month showed a good increase. The electrical engineering trade is a good customer for Sheffield products, and it is expected that a large amount of work will come to the city, directly and indirectly, in connection with the orders just announced by the Metropolitan-Vickers Electrical Company. That company, which has a large works here, has booked three contracts—each of them a repeat—for electric equipment for the Metropolitan, Southern, and New South Wales Government railways.

A Large Pipe Contract.

A very interesting item of local news this week is that the Stanton Ironworks Company, Ltd., has obtained a contract for 10,000 tons of cast iron pipes for Buenos Aires. The order was secured in the face of severe competition from foreign makers.

Marking of Imported Cutlery.

Employers and employees in the cutlery trade are alike pleased at the report of the Standing Committee appointed to inquire into the applications recently made for the marking of imported cutlery. The applicants were the Sheffield Cutlery Manufacturers' Association, the Sheffield Cutlery Council, and the Ironmongers' Federated Association. The Committee recommends that an indication of origin shall be borne—at the time of importation and of sale or exposure for sale—by the following classes of imported cutlery:—Knives, other than surgical knives or knives for use in machines; scissors, including tailors' shears and secateurs; razors other than safety razors; carving forks; knife sharpeners; safety razor blades and blades for any of the above-mentioned articles. The Committee found that the case for marking blanks or handles was not established. Representatives of the trade who have been interviewed with regard to the recommendations express general satisfaction with them, but regret that the marking is not to be enforced in the case of blanks as well as finished blades. "It cannot be too strongly emphasised," said one authority, "that the blank is the origin of the article that is going to be used. If the blank is worthless, the finished article will necessarily be worthless." Another point in which it is contended that the recommendations do not go far enough relates to safety razor blades. In their case, the indication of origin is not to be impressed on each article, but printed on the box or envelope containing the blades, and it is urged that this is not sufficient. It is pointed out that English blades sent to the United States of America have to be die-marked.

An Engineering Dividend.

It is satisfactory to know that, in spite of the many difficulties of the time, the Brightside Foundry and Engineering Company, of Sheffield, is able to continue the payment of dividends, if only moderate ones. For the third year in succession the distribution is to be 4 per cent., less tax. The profit for the year ended June last showed an increase on the previous year, being £7868, as compared with £5566.

A Halifax Change.

It is announced that the Campbell Gas Engine Company, Ltd., whose works are situated at Kingston, Halifax, has been purchased by George Cohen, Sons and Co., Ltd., of London. The works have in the past employed 1000 hands. The new owners are not yet able to make a complete announcement as to their plans for the future, but they are beginning operations with the manufacture of fifty oil engines, ranging in capacity from 3 to 40 horse-power.

Water Questions.

The problem of water supplies is exercising the minds of the authorities of Brigg, in Lincolnshire, and of Thurgoland, a village between Sheffield and Penistone. At Brigg the matter is causing anxiety on account of the failure of repeated attempts to discover new sources. Some years ago three bore-holes were sunk, but failed to yield water in sufficient quantity. Now the Council has had another hole sunk on the same site, going down first to 350ft., and then a further 3ft. through a bed of clay and carrying out a pumping test, but with no better result. The operations have cost £500. The Council is now under the necessity of looking round for some other source of supply, as the existing one is inadequate for the town's needs. In the case of Thurgoland, the surveyor to the Penistone Rural Council has prepared alternative plans, estimated to cost £2000, one of which is for tapping the Penistone main at Oxspring, and the other for pumping water from wells at Thurgoland, the chief objection to the latter being that in a dry period the wells might possibly fail altogether. The amount of water required for the district is about 80 million gallons a year. Now, a Thurgoland representative on the Rural Council reports that he has discovered a source of supply sufficient to meet the needs of the district at the Greenmoor quarries. There is said to be a constant supply of water, which has been proved, on analysis, to be suitable for all household purposes. A sub-committee has been appointed by the Rural Council to consider the possibility of the scheme.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Prospects.

BUSINESS has been largely held up this week in consequence of the annual trade holidays. A renewal of activity is not looked for until the beginning of September, when a movement in the direction of buying for autumn requirements should be experienced. While there is no apparent ground for great optimism, the outlook generally is certainly less discouraging than it has been, and indeed there is a growing feeling that market operations over the fall of the year will be characterised by a good deal of activity. Orders that have been held up are expected to be released in the near future, and the opinion prevails that customers are likely to discontinue their persistent pressure for price concessions and to make purchases on the terms now ruling. Iron and steel works are shut down for the holidays, but blast-furnaces are, of course, running.

Cleveland Iron Trade.

Sales of Cleveland pig iron are few and small, but stocks are not accumulating to any extent, ironmasters apparently being determined to restrict output to requirements. Very little iron is available for prompt disposal in the open market after delivery demands of running contracts have been met and provision has been made for makers' own consuming plant. Export demand continues light, but a few continental inquiries circulating encourage hope of some expansion of overseas trade.

Hematite Pig Iron.

Although business in East Coast hematite pig iron continues to fall vastly short of what could be desired, it is now on a scale that cannot be fully met by the limited output, and stocks are being steadily drawn upon. Values show a slight upward tendency, but are very unsteady, and orders are still obtainable only by makers accepting altogether unremunerative terms. Ordinary mixed numbers are seldom asked for, customers confining their purchases almost entirely to iron manufactured to specific analysis. Contracts on both home and export account have recently been arranged at figures ranging from 68s. to 71s., according to quality.

Ironmaking Materials.

Confident that inadequate supply will force up values, foreign ore merchants are urging consumers to return to the market, but the latter show no disposition to enter into new contracts. The actual termination of the Swedish ore miners' strike is expected to be announced this week-end. Consumers in this district have still fair quantities of Swedish ore stored, and while realising that some time must elapse before imports of moment can be looked for, they expect considerable quantities to arrive before the close of the shipping season. Best Rubio ore is quoted at 22s. 6d. c.i.f. Tees. Users of blast-furnace coke are not buying at all extensively. Good medium qualities are in the neighbourhood of 17s. 6d. delivered to works in this area.

Manufactured Iron and Steel.

There is no new feature in the manufactured iron and steel trade. Prices are steady, but business matures slowly. Demand for semi-finished steel shows little improvement, though quotations for continental material are barely competitive in inland districts. As regards finished steel, while sales are far from numerous,

producers of several descriptions have fairly substantial contracts to execute.

Work for Northern Firms.

Richardsons, Westgarth and Co., Ltd., Middlesbrough and West Hartlepool, have received an order from the Corporation of Douglas, Isle of Man, for the main equipment of the new power station to be erected at Pulrose. The reported contract value is over £28,000. Robert Stephenson and Co., Ltd., the Darlington firm of locomotive builders, have secured a contract for six locomotives and tenders for the Soudan Government. The receipt of this order, which follows closely upon the heels of that for four locomotives for the Ottoman Railway, ensures the works being well occupied for the next six months. W. Pickersgill and Sons, Ltd., the Wear shipbuilding firm, have secured an order for a 9000-ton vessel.

The Coal Trade.

The outlook in the Northern coal trade is a little brighter. The accumulation of orders on hand, combined with a fairly good circulation of new business, is placing several producers in a comfortable position, and all round there is prospect of fuller working time during the next few weeks. Orders on hand are numerous, but there is pronounced scarcity of shipping tonnage, owners holding out for enhanced rates, which is hitting c.i.f. shippers severely. Wherever possible, orders are being postponed until the freight market takes a more favourable turn. The position of Northumberland steam coals has improved. Most of the prospective output is fully stemmed, and whilst additional supplies are obtainable, fitters quote steadily at 13s. 6d. Durham steams, however, are less favourably situated through lack of tonnage. Gas coals generally are in a quiet prompt position, but the inquiry for all qualities for autumn delivery is becoming active. The bunker trade is flat. Supplies are readily obtainable, but prices are steadily held, superiors at 13s. 9d. to 14s. 9d., and good ordinary 13s. 3d. to 13s. 6d. The difficulty of securing tonnage is also affecting the coke trade. For prompt delivery, although makers are well sold, buyers are not taking out quantities, and the tone is easy for all makes. For next month and onwards bookings are satisfactory and inquiries numerous. Makers are quoting steadily: Gas coke at 20s. to 20s. 6d.; patent oven cokes, 17s. 6d. to 18s.; and beehive and special grades, 22s. to 27s.

SCOTLAND.

(From our own Correspondent.)

Important Shipbuilding Order.

AN item of unusual interest in the shipbuilding trade is the announcement of a contract for a cargo steamer of 8000 tons deadweight in which pulverised coal will be used as fuel. This vessel, which will be built by the Blythswood Shipbuilding Company, Ltd., Scotstoun, Glasgow, on behalf of the Berwindmoor Steamship Company, Ltd., Liverpool, will be the first built or owned in the United Kingdom in which this method of utilising coal will be employed. Raw coal carried in ordinary bunkers will be pulverised on board. The pulverising plant occupies little floor space, but rises through the decks to a fair height. The machinery and boilers will be of ordinary types, so that accurate comparisons, as regards economy and efficiency, can be made with existing installations.

Steel.

Apart from the settlement of the Swedish ore strike, there has been nothing of fresh interest reported during the past week. Some are of the opinion that ore prices will ease almost immediately, but the general opinion is that no appreciable change in the situation will be noticeable for a few months. The market on the whole is a shade more hopeful. Specifications for heavy steel have been more numerous of late, and some of the larger establishments are now more regularly employed. Sheets and tubes are comparatively well placed at present. The lighter varieties of sheets are still more in favour than the heavy descriptions, but sufficient orders have been received to ensure employment for some time ahead. The tube trade is busy in practically all branches, and it is said that some important contracts are in course of negotiation. Supplies of heavy steel scrap are limited, but the price is unchanged at 65s. per ton.

Iron.

The bar iron trade continues in a state of depression, and there is little hope of an early improvement. Rerolled steel, however, has been in better demand, and prices are firmer for export, the minimum quotation being £7 5s. per ton f.o.b. Cast iron scrap is unchanged at 62s. 6d. per ton. The pig iron trade is dull and inactive. Only some twenty-two furnaces are in blast.

Exports and Imports.

Imports at Clyde docks during the past week included 6200 tons of iron ore and 2700 tons of iron and steel products. Exports of steel and iron amounted to 4800 tons and pig iron shipments 735 tons. Pig iron imports amounted to 2300 tons.

Coal.

While export business is still slow, the collieries have on occasion more than they can do to satisfy all demands, owing to the restricted output. In all districts round coals are moving away steadily at firm prices, but there is a distinct scarcity of washed materials. In fact, the latter are practically unobtainable for at least two weeks ahead, and for any small lots which become available very firm prices are demanded. Owing to this shortage there is a possibility that outputs may be increased very shortly. Aggregate shipments during the past week amounted to 230,448 tons, against 221,519 tons in the preceding week and 280,155 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

ON the whole, there has been no change in the general conditions prevailing in the steam coal area during the past week. No new feature has developed. The chief trouble is that there is a shortage of new business, and nothing has arisen to strengthen the market, with the result that prices for practically all descriptions are at the minimum, and, as might be expected in the circumstances, such orders as are about are mainly for the superior coals in each class. Inferior coals only get a chance when the better grades are fully sold, and the sellers of them are in a sufficiently good position to quote something above the minimum. The general situation can be gauged from the fact that at the end of last week there were altogether thirty idle tipping appliances at the various docks. On Tuesday conditions were a shade better, as there were twenty-six idle tipping appliances with six steamers waiting to berth. Although chartering last week was slightly more active than during the previous week, it was not on a sufficiently brisk scale to encourage the belief that collieries are in for a much better time. A fair number of orders are, of course, held by exporters, and it is still the case that tonnage is not offered too freely, otherwise collieries in some instances might be better placed than they are at the moment. So far as contract operations are concerned, it can now be stated that the Egyptian State Railways have allocated their business for the next three months. Instead of buying 90,000 tons as was at first reported, it now appears that they have accepted the tender of T. Beynon and Co., Ltd., for 140,000 metric tons at the price of 27s. 1d. per ton, c.i.f. Alexandria, for the coals on the Administration list, this price comparing with 26s. 8d. per ton c.i.f. in respect of the last contract for the supply of 340,000 metric tons, which was secured by Watts, Watts and Co.

Coalfield Items.

The report is current that Sir D. R. Llewellyn has made an offer for the purchase of the International Collieries, and that the matter will shortly come before the court in London. On Saturday last the long-standing dispute between the management and the workmen at the Abergorchy Colliery, Treorchy, was settled, the men agreeing to accept the terms offered. Half the workmen at the colliery have been idle for the past four months, and last week the announcement was made that if terms were not agreed to, the colliery, which is under the control of the Ocean Coal Company, would be closed down. At a miners' delegate conference held at Cardiff on Monday the decision was come to to adopt a centralisation scheme. The Executive Committee was instructed to formulate a new centralisation scheme for the consideration of the lodges within the next two months, and to submit it to another conference to be held in four months. With respect to contributions, there was considerable diversity of opinion. In South Wales and in most of the other districts the rate of contribution is 6d. per week, while in others it is 1s. per week. The South Wales delegates negatived the suggestion of the Miners' Federation of Great Britain that the rate of contribution should be 1s., and decided in favour of the continuance of the present contribution of 6d. per week.

Tin-plate Trade.

The report emanates from Swansea that the Asiatic Petroleum Company has placed an order for a quarter of a million boxes of Welsh tin-plates for delivery during the first half of next year, and that a large proportion of the order will be executed at the new Elba Works, Swansea. It is understood that agreement has now been arrived at on the question of the rates payable to box-makers at the Elba Works and others where the metal tin-plate boxes are being used in preference to the old type of wooden covers. This question has been under negotiation for some considerable time past.

Ship-repairing.

The conditions in the ship-repairing industry have been very quiet in this district for some time, but this week have displayed indication of some improvement. Orders of a heavy description have been extremely few, but it is reported that C. H. Bailey, Graham and Co., Ltd., have obtained the contract for the repair of the London steamer "Whitegate," which was dry-docked at Cardiff on Monday. This steamer sustained bow damage through colliding with a quay wall, as well as other slight damage as a consequence of colliding with another steamer. The contract was put up for tender among South Wales firms. It is stated that the work will take about twelve days to carry out, and is estimated to be worth about £1500.

Current Business.

There has been very little activity on the steam coal market during the past week. Sized and small coals have displayed a very steady tone, relatively speaking, owing to the curtailed supplies as the result of the intermittent working of collieries, but large coals have been slow to move off. Stocks of the latter are in excess of the demand, which does not show any material expansion, and prices remain at the minimum. The inquiry for patent fuel and coke also leaves much to be desired, but pitwood is firm as the result of supplies being on the short side, and prices range about 28s. 6d. to 29s.

WORK has been started on the construction of a kraft paper mill at Mobile, Alabama, which will have an output of 170 tons a day.

LAUNCHES AND TRIAL TRIPS.

CASPIA, single-screw oil tanker; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Overseas Oil and Transport Company, Ltd.; dimensions, 427ft., 53ft.; 8475 tons deadweight on a mean draught of 25ft. Engines, direct-acting surface condensing triple-expansion; pressure, 180 lb. per square inch; trial trips, August 8th and 14th.

BRITISH PLUCK, steel-screw motor ship; built by Swan, Hunter, and Wigham Richardson, Ltd., to the order of British Tanker Co., Ltd.; dimensions, 240ft. by 32½ft. beam; 1000 tons deadweight on a draught of 12ft. Engines, Neptune Polar Diesel engines; six cylinders, 420 mm. bore and 720 mm. stroke; constructed under licence from the Atlas Diesel Company, Ltd., Stockholm, by the builders; a speed of 10¾ knots was attained on trial trip, August 14th.

WISŁA, steel-screw steamer; built by Craig, Taylor and Co., Ltd., to the order of the Polish Ministry of Industry and Trade, Warsaw; dimensions, 337ft. by 49ft. by 24ft. 3in. Engines, triple-expansion, 23½in., 39in., and 64in. by 42in. stroke; pressure, 180 lb. per square inch; constructed by North-Eastern Marine Engineering Company, Ltd.; a speed of 12¼ knots was attained on trial trip, August 14th.

BENEDICK, oil tanker; built by Blythswood Shipbuilding Company, Ltd., to the order of Bear Creek Oil and Shipping Co., Ltd., of Liverpool; dimensions, 440ft. by 58ft. by 32ft. 9in.; 10,300 tons deadweight. Engines, Diesel single-acting four-stroke cycle; six cylinders, 740 mm. diameter and 1500 mm. stroke; constructed by J. G. Kincaid and Co., Ltd., Greenock; a speed of 11⅞ knots was attained on trial trip, August 15th.

BEHAR, single-screw steamship; built by Harland and Wolff, Ltd.; to the order of Hain Steamship Company, Ltd., Cardiff; dimensions, 452ft. 6in. by 57ft. 4in. by 40ft. 9in. Engines, quadruple-expansion, 30½in., 44in., 63½in., and 91in. diameter by 60in. stroke; pressure, 230 lb. per square inch; constructed by the builders; launch, August 16th.

GRACEFIELD, single-screw cargo steamer; built by Swan, Hunter, and Wigham Richardson, Ltd., to the order of E. J. Sutton and Co., Newcastle-on-Tyne; dimensions, 400ft. by 53½ft.; 8000 tons deadweight on a 24ft. draught. Engines, triple-expansion; constructed by the builders; a speed of 12¼ knots was attained on trial trip, August 16th.

LADY HAWKINS, passenger and cargo vessel; built by Cammell Laird and Co., Ltd., Birkenhead, to the order of Canadian National (West Indies) Steamships, Ltd., Montreal; dimensions, 437ft. 3in. by 59ft. by 31ft. Engines, two sets single-reduction geared turbines, Parsons type; constructed by the builders; launch, August 16th.

SINNINGTON COURT, single-screw steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of United British Steamship Company, Ltd., dimensions, 420ft. by 56ft. 2in. by 36ft. 4½in.; 9000 tons deadweight. Engines, inverted direct-acting triple expansion, 27in., 45in., by 75in. by 51in. stroke; pressure, 180 lb. per square inch; constructed by J. G. Kincaid and Co., Ltd., Greenock; launch, August 16th.

PATO REAL, motor tug; built by J. I. Thornycroft and Co., Ltd., to the order of Forestal Land, Timber and Railway Co., Ltd.; dimensions, 54ft. by 13ft. 6in. by 6ft. Engines, Bolinder two-cylinder; launch, August 17th.

S.A.C. 6, ore-carrying steamship; built by Swan, Hunter, and Wigham Richardson, Ltd.; to the order of Sociedad Anonima Cros, Barcelona; dimensions, 297ft. by 43ft.; 4100 tons ore. Engines, triple-expansion; constructed by North-Eastern Marine Engineering Company, Ltd., Sunderland; a speed of 10·4 knots was attained on trial trip, August 20th.

KERMA, steel screw cargo steamer; built by David and William Henderson and Co., Ltd., Partick, Glasgow, to the order of Frank C. Strick and Co., Ltd., London; dimensions, 370ft. by 52ft. 3in. by 28ft. 3in.; 4350 gross tonnage. Engines, triple-expansion, 24½in., 41in. and 66in. by 45in. stroke, pressure 180 lb. per square inch; constructed by the builders; launch, August 21st.

CATALOGUES.

CAMPBELL AND ISHERWOOD, Ltd., Raleigh-street, Bootle, Liverpool.—Leaflet on portable electric grinders.

THE MOND NICKEL COMPANY, Ltd., Victoria Station House, S.W. 1.—August issue of the *Mond Nickel Bulletin*.

F. J. GORDON AND CO., Ltd., 92, Charlotte-street, W. 1.—Particulars of a new lubricant, known as "Kant-Rust."

MATHER AND PLATT, Ltd., Park Works, Manchester.—"The Electric Drive in the Bleaching, Printing, Dyeing and Finishing Trades."

BRIERLEY, SONS AND CO., School-street, Newton Heath, Manchester.—A booklet on modern methods of dust removing for the engineering trades.

SIEBE, GORMAN AND CO., Ltd., 187, Westminster Bridge-road, S.E. 1.—Catalogue B 5 of breathing and all other safety, protective and first-aid appliances.

J. W. BROOKE AND CO., Ltd., Adrian Works, Lowestoft.—Catalogue No. M/M 29, giving specifications of the various types and sizes of marine motors the company manufactures.

E. H. JONES (MACHINE TOOLS), Ltd., Britannia Wharf, Baldwin-terrace, Islington, London, N. 1.—Brochure, Raboma radial drilling machines; leaflets 728 and 828, Diskus face grinding machines.

SULZER BROS., 31, Bedford-square, London, W.C. 1.—A well-illustrated brochure descriptive of the firm's two-cycle Diesel engines from 25 to 10,000 B.H.P. for marine and industrial use, with examples of typical installations in various parts of the world.

THE BRITISH ALUMINIUM COMPANY, Ltd., Adelaide House, King William-street, E.C. 4.—"Aluminium Casting Alloys: A Review of Recent Progress," a reprint of a paper read before the Institute of British Foundrymen by Mr. George Mortimer, also booklet, "Aluminium in the Rubber Industry."

A SUCCESSFUL BRITISH MOTOR BOAT.—In the three 30-mile international races for the Atlantis Trophy, which were recently run at Southampton, the successful boat was Mr. Mawdsley Brooke's 24ft. 100 H.P. "Seacar," which was driven by Mr. Jack Brooke. This boat was, we are informed, the only British boat to compete against standard American productions. The trophy, which is presented by Mr. Hugh Tevis, has to be completed for by standard motor craft which do not exceed 26ft. in length or 180 horse-power. It is awarded for the highest attained speed with the lowest lap time variation over the series of races. Mr. Brooke's "Seacar" showed a total time lap variation over the three 30-mile races of only one minute and forty-one seconds, and the average speed was 23·13 knots, or about twenty-seven miles per hour. The new 100 B.H.P. engine propelling the boat was designed and built by J. W. Brooke and Co., Ltd., of Lowestoft, and it was described in THE ENGINEER of September 23rd last on the occasion of the Shipping, Engineering and Machinery Exhibition at Olympia.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	19/- to 21/-
(1) Spanish	19/- to 21/-
(1) N. African	19/- to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 8 0	3 8 0
No. 1	3 8 6	3 8 6
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 0 to 2 17 0	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	2 19 0 to 3 0 0	—
Forge	2 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 0	—
No. 4 Forge	2 18 6	—
Basic	2 19 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (a) / 4 4 6 (b) / 4 8 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 15 0 to 9 0 0	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G.)	13 12 6	13 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 15 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6	—
,, (Lancs. Boiler)	9 12 6 to 9 17 6	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 and 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0 to 6 7 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
Midlands—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 2 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 10 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	211 17 6
,, (three months)	207 15 0
Copper (cash)	62 7 6
,, (three months)	62 16 3
Spanish Lead (cash)	21 12 6
,, (three months)	21 11 3
Spelter (cash)	24 8 9
,, (three months)	24 11 3
Manchester—	
Copper, Best Selected Ingots	67 0 0
,, Electrolytic	69 10 0
,, Strong Sheets	94 0 0
,, Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0
,, Condenser, lb.	0 1 2
Lead, English	23 10 0
,, Foreign	22 0 0
Spelter	24 17 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£20 10 0	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£20 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£38 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£44 0 0	17/-
,, ,, ,, carbon free	1/1 per lb.	
Metallic Chromium	2/8 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 5 0	scale 5/- per unit
,, ,, 75 p.c.	£19 0 0	scale 6/- per unit
,, Vanadium	14/3 per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/3 to 14/6
,, ,, Splint	16/- to 17/-
,, ,, Trebles	13/3
,, ,, Doubles	13/-
,, ,, Singles	12/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	13/6 to 13/9
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/- to 12/9
Screened Navigation	18/-
Trebles	13/6 to 14/-
Doubles	13/6 to 13/9
Singles	12/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/3
Secondary Steam	11/9
Trebles	13/6
Doubles	13/3
Singles	12/6

ENGLAND.

(8) N.W. Coast—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/3 to 13/6
Second Steams	11/9 to 12/-
Steam Smalls	9/- to 9/6
Unscreened	11/9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	15/-
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	18/3 to 19/-
Sheffield—	Inland.
Best Hand-picked Branch	26/- to 27/6 —
Derbyshire Best Bright House	19/6 to 20/6 —
Best House Coal	18/6 to 20/- —
Screened House Coal	16/- to 17/- —
,, ,, Nuts	14/- to 15/6 —
Yorkshire Hards	14/- to 16/- —
Derbyshire Hards	14/- to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	5/- to 6/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	19/- to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/-
Best Dry Large	18/- to 18/6
Ordinary Dry Large	17/3 to 17/9
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/3
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	10/6 to 12/-
Washed Nuts	16/6 to 18/6
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	27/- to 36/-
Furnace Coke (export)	20/- to 20/6
Patent Fuel	21/- to 22/-
Pitwood (ex ship)	29/- to 29/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 35/-
Seconds	24/6 to 27/-
Red Vein	20/6 to 27/-
Machine-made Cobbles	40/- to 43/-
Nuts	35/- to 43/-
Beans	23/6 to 26/-
Peas	18/- to 19/-
Breaker Duff	8/- to 8/6
Rubbly Culm	12/- to 12/6
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Steel for Export.

For some time past it has been known that German steelmakers were seeking to form a central office amongst the members of the Steel Union for the sale of steel products in foreign markets, particularly those outside Europe. It is now stated from German sources that the negotiations are being held up by the opposition, mainly, of Belgian producers, who do not want to be deprived of the advantages they possess in the way of low costs when competing for foreign business. So far as French steelmakers are concerned, the home demand is absorbing quite enough of the steel production to leave them indifferent as to what is taking place in South America, the Far East and other markets which it is hoped to control with the new Sales' Office; but the Germans are obliged to rely more largely on the foreign trade, and they are raising the spectre of competition from the United States, which are making keen efforts to find markets for the disposal of an increasing surplus production of steel. A little while ago it was stated that the threatened British competition was as serious as the American. Now it is suggested that British steelmakers should join the continental producers in organising the export trade to distant markets; but, while there is so much difficulty in keeping steel producers together in the interests of European trade, it is probable that negotiations for an export organisation will be particularly arduous.

Rail and Road Traction.

The railway companies have been examining for a long while past the various aspects of the problem arising out of the competition of road vehicles, which has become a matter of serious concern for the future. Traffic is being diverted from the railways to the road in a way that has made it imperative for the companies to settle upon a definite policy which will enable them to meet the new conditions. They labour under serious disadvantages through the much higher charges imposed upon them than on road users, and also through the facility with which motor vehicles can be adapted to cross country traffic, whereby the "secondary" or local lines are in danger of being abandoned altogether. The railway companies have come to the conclusion that it is useless to attempt to compete with motor car traffic. Not only do commercial vehicles pay little in the form of taxes, but public services are usually subsidised, so that for certain kinds of traffic the railways are placed at a great disadvantage. The railways must, therefore, adapt themselves in some way to the progress of road motor traction. The idea of granting the railway companies a direct monopoly of road transport was objectionable for several reasons, principally because it would involve trouble with private interests that are engaged all over the country. A scheme was thereupon prepared by M. Paul, managing director of the Chemins de Fer du Midi, and presented to all the transport interests, and upon it has been based a sort of programme which will be submitted shortly by the Minister of Public Works for acceptance by all the public and private transport concerns. In connection with each railway company there will be formed a Société Auxiliaire de Transports to which will belong all the existing public and private concerns operating within the region covered by that company. Most of the capital will be subscribed by the railway company, which will thus have a controlling interest, but the auxiliary company will be independent of the railway in the sense that the private interests will be maintained, although the services will have to be run according to plan, and new lines will be created where necessary. As there will be as many Sociétés Auxiliaires de Transports as there are railway companies, and all will be under the control of the central railway managing committee, the scheme really amounts to an amalgamation of all the road transport services throughout the country. The services will be organised according to a definite plan which aims at developing traffic in districts away from the railways, to which the motor vehicles will, at the same time, act as feeders. They will also link up the railways across country. The scheme is not restricted to motor car traffic, but covers every means of transport, including air services and inland waterways where the latter are used for the transport of tourists. The auxiliary companies will, in fact, have a free hand in organising passenger and goods transport in any form, on condition that existing interests are safeguarded.

Colonial Works.

The harbour, railway and other works being carried out in the Colonies are providing employment to the engineering industries, and orders are likely to continue to come forward for some years in view of the programmes, involving a steadily increasing annual expenditure, that have been put in hand. Much of the material will be supplied by Germany on account of reparations, but a good deal will be obtained in France where manufacturers are looking to the Colonies as improving markets for their products. In Morocco the expenditure this year on hydraulic works alone is estimated at 29 million francs. The Compagnie des Chemins de Fer du Maroc Oriental, which was formed last year, is building a line 185 miles long for the transport of manganese to Oudjda and Oran, and next year the line from Oudjda to Fez will be started upon. The electrification programme in Morocco also constitutes an element of activity. Work continues with the equipment of Casablanca, which has become the fifth French port as regards tonnage, laden and unladen, and the port of Dakar, in French West Africa, is also being extended, while contracts for the construction of wharves are to be given out for Noumea and Jibuti. Amongst other contracts is that for a bridge for Indo-China. All this work constitutes only a small part of the orders which are to be distributed for the carrying out of the programmes of Colonial development, and while they can only be executed with the aid of German reparations, they nevertheless supply acceptable employment to constructive engineers and others who are looking to the future with confidence. The only element of uncertainty lies in the attitude of Germany with regard to the question of reparations.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

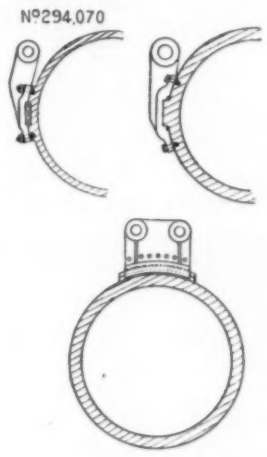
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

294,070. January 13th, 1928.—SUPPORTING THE DRUMS OF STEAM GENERATORS, H. S. Horsman, 140, Albert-place-mansions, Battersea Park, London, S.W. 11.

This invention relates to improvements in drums for high-pressure boilers and more particularly to improvements in means by which such drums may be supported at a point or points intermediate their ends. Such drums are formed with annular ribs, local enlargements or swellings at spaced points in their

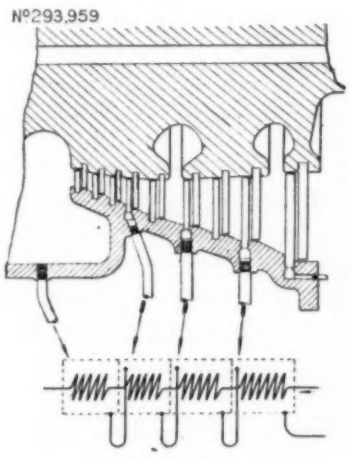


lengths, and such swellings or enlargements are cut away to provide shoulders or recesses or keyways adapted to be engaged by or keyed to supporting means from which the drums are suspended by slings or the like. The illustrations show some alternative methods of carrying out the invention.—*July 19th*, 1928.

TURBINE MACHINERY.

293,959. June 14th, 1927.—STEAM TURBINES, The English Electric Company, Ltd., Queen's House, Kingsway, London, W.C. 2, and J. C. Chittenden, Willans Works, Rugby.

It is well known that the existence of water in the form of very small drops in the middle and lower-pressure stages of a multi-stage steam turbine is a serious disadvantage, both from the point of view of efficiency and of wear of blading. This

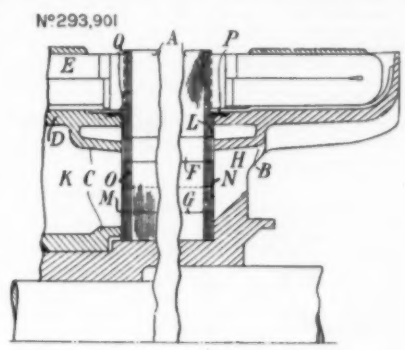


disadvantage becomes more important as the hydraulic efficiency of the blading is improved. In order to meet these conditions, the inventors draw off the wet steam projected from the blading by centrifugal force, at various points along the casing, and utilise this steam for feed-heating purposes. The steam is withdrawn through holes in the spacing pieces at the roots of the fixed blades.—*July 19th*, 1928.

DYNAMOS AND MOTORS.

293,901. April 14th, 1927.—IMPROVEMENTS IN OR RELATING TO DYNAMO-ELECTRIC MACHINES, George Herbert Fletcher, of 22, Glentilt-road, Ecclesall, Sheffield, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

According to this invention, the end of a rotor between the laminations and the end plates is sealed to prevent the penetration to the end windings of foreign bodies, such as dust, which may be carried by the ventilating air there passes through the armature core. In the usual construction of a rotor laminations are clamped between rigid end plates on the shaft. It is not practicable, however, to obtain laminations which are of absolutely uniform thickness, and consequently in an assembled rotor, the total thickness at various points around the periphery of the rotor may vary and spaces, into which foreign bodies, such as dust, may penetrate, may be left between the end laminations and the rigid end plate. According to this invention, a special plate having an outstanding rim or flange is interposed between the rigid end plate and the laminations, and the outstanding rim is seated in a recess in the end plate. The laminations A are clamped against the end plate B by means of a second end plate C, which is provided with an extension D to support the ends of the rotor windings. Ducts F and G are provided for the circulation of cooling air and communication with orifices H and K in the end plates. Between the laminations and the end plates there are stout plates L and M. A packet of punchings N, which are thicker than the ordinary laminations,

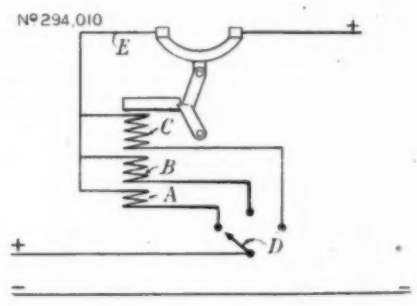


is welded to the plate L, and a similar packet of laminations O is welded to the plate M, so that the two end pockets of laminations are stouter than those used for the bulk of the core. The plates L and M are provided with outstanding rims P and Q, which are rolled into circumferential channels formed in the end plates. The joints may be filled in with cement or enamel.—*July 16th*, 1928.

SWITCHGEAR.

294,010. September 6th, 1927.—IMPROVEMENTS IN OR RELATING TO ELECTRICAL SWITCH MECHANISM, William Rea, of 66, The Downs, Altrincham, Cheshire.

The object of the invention is to provide an improved automatic overload circuit breaker for use in a circuit to which apparatus of different powers is alternatively connected. The solenoid for operating the switch is provided with three independent windings A, B and C, which are represented as two-turn, three-turn, and four-turn windings. These windings are each connected to a terminal of a selector switch D and to the

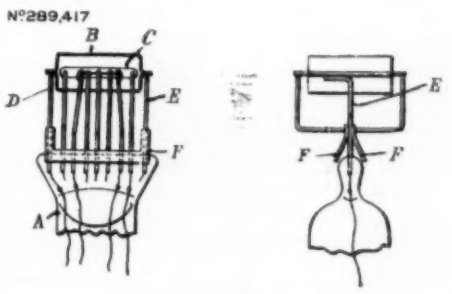


common lead E from the switch. The selector switch D is connected to the positive main. By this arrangement the selected solenoid winding is placed in series with the mains. The selector switch can be set to the position at which the automatic action of the switch will operate to protect the particular apparatus in use, the smaller and heavier solenoid winding A being suited for the larger apparatus while the larger and lighter windings C and D, having a greater number of turns, will actuate the switch at lower currents and therefore are suitable for protecting the medium or smaller power apparatus respectively.—*July 19th*, 1928.

TELEGRAPHS AND TELEPHONES.

289,417. July 6th, 1927.—IMPROVEMENTS RELATING TO THERMIONIC VALVES OR ELECTRON DISCHARGE TUBES, N. V. Philips' Gloeilampenfabrieken, of Emmasingel 6, Eindhoven, Holland.

This invention is concerned with the insulation of the parts of valves across which there is a potential difference. It is well known that thermionic valves are liable to be unsatisfactory in operation on account of lack of effective insulation between the leading-in wires of the various electrodes and other parts which are maintained at different potentials. In particular, the deposit of small particles of metal on the pinch at the inner end of the re-entrant stem of the valve, into which leading-in wires are sealed, often leads to a leakage of current between the leading-in wires. This is particularly the case, for example, when, as is the common practice, magnesium is volatilised within the valve

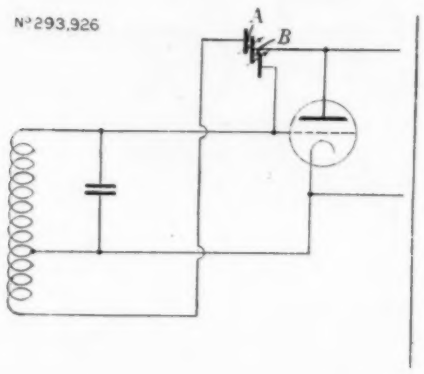


in order to clean up the vacuum. This pinch A carries an anode B enclosing a grid C, which, in its turn, encloses the filament. The anode is carried upon two supports D and E, the support D serving also as the leading-in conductor for the anode. Two screens F, each comprising a protecting strip, extend along and above the surface of the pinch, one strip being arranged on either side of the electrode leading-in conductors and supports, and each strip is secured at its ends to the anode supports D and E by means of short extensions at right angles. These short extensions of the screens F are bent, so that the screens slope downwards at an angle to the vertical and protect the upper surface of the pinch from the deposit of any metal particles

volatilised within the valve during the process of cleaning up the vacuum. The screens are made of metal, a particularly suitable metal being nickel.—*July* 19th, 1928.

293,926. April 26th, 1927.—IMPROVEMENTS IN OR RELATING TO RADIO APPARATUS, Burndept Wireless, Ltd., of Aerial Works, Blackheath, London, S.E. 3; and Charles Francis Phillips, of 17, Eliot Vale, Blackheath.

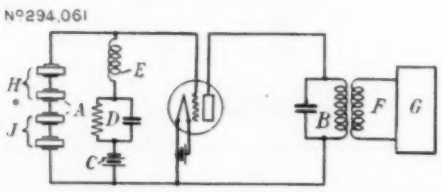
In balancing out the capacity of radio apparatus—the capacity between the grid and plate of a valve, for instance—it sometimes happens that, even at the zero setting of the balancing condenser, the capacity is not low enough to give the desired degree of balance, and the object of this invention is to overcome



the difficulty. In the diagram A is the variable condenser and B a second condenser arranged so that the capacity of one condenser increases and diminishes as that of the other diminishes and increases, each having its maximum capacity when the capacity of the other is zero. The arrangement is said to give a very smooth control.—*July* 19th, 1928.

294,061. December 31st, 1927.—IMPROVEMENTS IN CRYSTAL-CONTROLLED HIGH-POWER OSCILLATORS AND AMPLIFIERS, *Standard Telephones and Cables, Ltd., of Connaught House, Aldwych, London, W.C. 2.*

One of the objects of the invention is to increase the amount of power that can be controlled by a Piezo electric element. Another object is to reduce undesired variations due to temperature changes, as, for example, variations in the frequency of a crystal-controlled electric space discharge oscillator, owing to temperature variations of the crystal control device. The three-electode valve has an input circuit which includes four Piezo electric crystals A connected in series with a tuned circuit B. It is not, however, necessary to tune the plate circuit. A source of negative potential C, a condenser and grid leak condenser D, and a choke coil E are shown connected across the grid and filament for supplying biasing potential to the grid. If

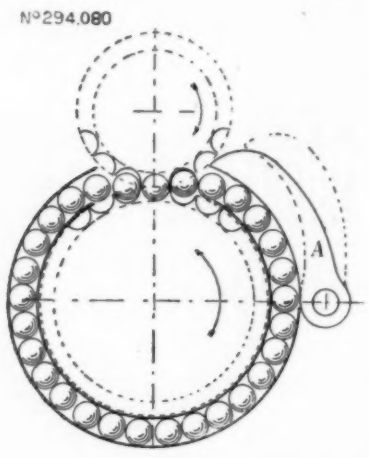


a choke coil is not used the by-pass condenser across the resistance may be omitted. The plate circuit is coupled by a coil F to the load circuit G, the oscillator being of the well-known Hartley type. The voltage across the crystal separating any two opposing plates is but a portion of the total voltage, and as a result the plate voltage of the oscillating valve and consequently the power output can be greatly increased without danger to the crystal. To reduce variations in the frequency of the controlled oscillator due to temperature changes, some of the crystals may have temperature coefficients of frequency opposite in sign to those of the other crystals. The two crystals marked H are supposed to have positive temperature coefficients and those marked J negative temperature coefficients. A method of overcoming the difficulty of making the four crystals identical is described.—*July* 19th, 1928.

TRANSMISSION OF POWER.

294,080. January 30th, 1928.—GEARING, F. Raimond, Via Marcona 77, Milan, Italy.

With this gearing the drive is transmitted from one toothed wheel to another by the interposition of balls or rollers in the

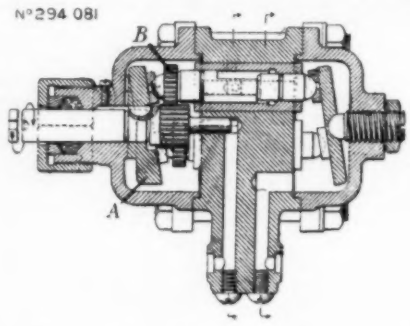


notches between the teeth. The balls are conveyed round the periphery of one of the wheels in a closed channel, and are fed into the notches near the point of engagement of the wheels. Part of the cover of the channel is hinged, as shown at A, and can be swung back. When this part is swung back the balls are no longer fed into the engaging region, but are thrown out by centrifugal force and the drive is interrupted.—*July* 19th, 1928.

PUMPING AND BLOWING MACHINERY.

294,081. February 1st, 1928.—MULTI-CYLINDER PUMPS, *L. Mellersh-Jackson, 28, Southampton-buildings, Chancery-lane, London, W.C. 2.*

It would appear that the most important feature of this pump, which is of the multi-cylinder, swash-plate type, is the combination of a rotary motion with that of reciprocation of the

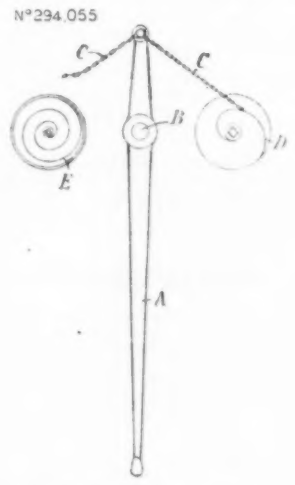


pistons. The swash-plate effect is produced by the cam A, and the rotation by the gears B. The rotation of the pistons is employed to open and close the inlet and outlet ports, and also facilitates lubrication.—*July* 19th, 1928.

SHIPS AND BOATS.

294,055. December 23rd, 1927.—STEERING GEAR, H. M. Fellows and J. M. Fellows, 76, Southtown, Great Yarmouth.

It is claimed that this mechanism gives assistance to the steersman. The tiller A is extended aft of the rudder stock B, and to this extension there are attached two chains C C. These

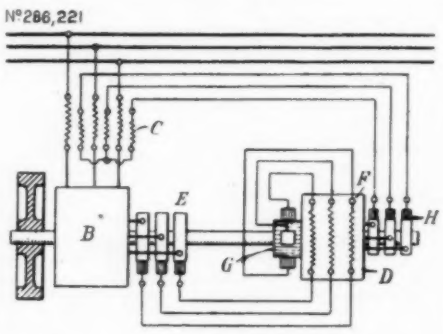


chains are wrapped round fusees D, which are controlled by spiral springs E. It is said that the arrangement does not influence the tiller when it is amidships, but assists the steersman to an increasing extent as the helm is put over.—*July* 19th, 1928.

MISCELLANEOUS.

286,221. February 21st, 1928.—ASYNCHRONOUS MOTOR CORRECTED BY MEANS OF A FREQUENCY CHANGER, Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, Switzerland.

In driving rolling mills by means of asynchronous motors, it is necessary to provide, on the one hand, extensive power factor correction, and, on the other hand, a considerable diminution of speed in order to bring the fly-wheel into action for absorbing sudden fluctuations in the load of the mill. In the drawing, the three-phase supply main feeds the asynchronous motor B through the current transformer C. The frequency changer D runs on the same shaft—or may also be



driven through a suitable transmission gear. The slip rings E of the asynchronous motor B lead through the compensating winding F of the frequency changer to the collector G of this machine. The armature winding of the latter is provided with slip rings H, which are excited from the secondary side of the current transformer C. The correction and speed characteristic can be varied considerably by parallel connection with controllable variable resistances in the secondary side of the current transformer.—*July* 12th, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, AUGUST 25TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the plant of the Stafford Coal and Iron Company, Ltd., at Stoke-on-Trent. Leave London-road Station, Manchester, at 9.15 a.m.

THURSDAY AND FRIDAY, SEPTEMBER 6TH AND 7TH.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.—Annual general meeting in the Masonic Hall, George-street, Edinburgh. 10 a.m., discussion upon Mr. R. M. Simpson's paper, "Lands Valuation and Income Tax Charges;" William Young Memorial Lecture, by Dr. Charles Carpenter, C.B.E., London. 2.30 p.m., paper by Mr. George Braidwood, Coatbridge, "Quality." The Lord Provost, Magistrates, and Councillors of the City of Edinburgh invite the members and friends to a reception in the City Chambers, on Thursday, September 6th, at 8 p.m. The excursion on September 7th will be by train to Melrose, leaving Edinburgh (Waverley Station) at 10.10 a.m.

SATURDAY, SEPTEMBER 8TH.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Great Yarmouth. Eastern District meeting. 11 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Morpeth. North-Eastern District. 2 p.m.

TUESDAY TO FRIDAY, SEPTEMBER 4TH TO 7TH.

THE INSTITUTE OF METALS.—Annual autumn meetings at Liverpool. For programme see page 129, August 3rd.

SATURDAY, SEPTEMBER 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the locomotive works of the Vulcan Foundry, Ltd., Newton-le-Willows. Train leaves Exchange Station, Manchester, at 8.55 a.m.

CONTRACTS.

ROBERT STEPHENSON AND CO., LTD., of Darlington and 25, Victoria-street, Westminster, S.W. 1, have recently received the following orders:—(*a*) From the Ottoman Railway from Smyrna to Aidin, for four 2–8–2 type engines, with superheaters having multiple valve regulators, and tenders. This order was obtained in spite of keen foreign competition; (*b*) from the Sudan Government Railways, for five heavy "Mikado"-type superheater engines with double bogie tenders, and one "Prairie" 2–6–2 superheater engine with double bogie tender; and (*c*) from the Buenos Aires Pacific Railway Company for twelve boiler shells.

MIRRLEES BICKERTON AND DAY, LTD., of 7, Grosvenor-gardens, Westminster, S.W. 1, have received the following orders:—(*a*) For the Barnstaple Corporation Electricity Works, one 180 B.H.P. three-cylinder "Mirrlees-Diesel" engine coupled to a dynamo of the Electric Construction Company's manufacture; (*b*) from Marconi's Wireless Telegraph Company, Ltd., for two 220 B.H.P. four-cylinder "Mirrlees-Diesel" engines and Crompton-Parkinson dynamos; and (*c*) from the Frinton-on-Sea and District Electric Light and Power Conmapny, for a "Mirrlees-Diesel" engine of 300 B.H.P., to be coupled to a dynamo ordered from the General Electric Company, Ltd.

THE INTERNATIONAL COMBUSTION ENGINEERING CORPORATION of New York has received from the New York Edison Company an order for four complete steam generating units, each of which is guaranteed to produce 550,000 lb. of steam per hour on normal load, with an overload capacity of 800,000 lb. of steam per hour. The boilers will be of the double Ladd type, and will be designed for a maximum pressure of 500 lb. and an operating pressure of 425 lb. The furnaces will be equipped with C-E fin tubes, C-E fin tube arch screens, Lopulco water screens, Lopulco (couch type) burners, and Lopulco type R feeders. Eight C-E air preheaters will be installed. The pulverising plant will consist of six Raymond super-mills.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., of Trafford Park, Manchester, has received orders for:—(*a*) Seventy-two motor coach equipments and fifty-eight trailer coach equipments for the Southern Railway for use in connection with the conversion of part of the Central Section (late London, Brighton and South Coast Railway) of the suburban system from single-phase alternating-current operation with overhead line to direct-current operation with third rail; each motor coach is to be equipped with two 275 H.P. motors; and (*b*) for the supply of 100 motor coach equipments and 100 trailer coach equipments for the Sydney, N.S.W., Suburban Railways. The motors, two for each motor coach, are units of 360 H.P., which is thought, probably, to be the most powerful individual motors ever installed for multiple unit trains. The control gear is to be electro-pneumatic.

THE TOD RIVER WATER SCHEME.—With reference to the article on the Tod River Water Scheme, which was published in our issue of August 10th, we are asked by the Premier Gas Engine Company, Ltd., of Sandiacre, near Nottingham, to state that it was the maker of the gas engines mentioned as being employed to drive the pumps for lifting water into the Knott's Hill Reservoir. Its contract comprised the supply of two four-cylinder, horizontal engines, each to develop 360 B.H.P. as a normal working load, and a maximum of 468 B.H.P. for short periods, at a speed of 200 r.p.m.

THE FIRST NATIONAL GLASS CONVENTION.—The First National Glass Convention will be held at Bournemouth from September 19th to 22nd, 1928. It will be presided over by Mr. W. Butterworth, President of the Society of Glass Technology. The meetings will be devoted to discussions on the organisation of the glass industry, with a conference on legislation. A preliminary brochure containing the programme will be sent to anyone connected with the British glass industry upon application to either of the joint secretaries of the glass convention; Professor W. E. S. Turner, Society of Glass Technology, Darnall-road, Sheffield; or Mr. Geoffrey Marchand, Glass Manufacturers' Federation, Aldwych House, London, W.C. 2.